GT-6000

SERVICE MANUAL

EPSON

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PRECAUTIONS

Precautionary notations throughout the text are categorized relative to 1) personal injury, and 2) damage to equipment:

DANGER Signals a precaution which, if ignored, could result in serious or fatal personal injury. Great caution should be exercised in performing procedures preceded by a DANGER headings.

WARNING Signals a precaution which, if ignored, could result in damage to equipment.

The precautionary measures itemized below should always be observed when performing repair/maintenance procedures.

DANGER

1. ALWAYS DISCONNECT THE PRODUCT FROM BOTH THE POWER SOURCE AND THE HOST COMPUTER BEFORE PERFORMING ANY MAINTENANCE OR REPAIR PROCEDURE.
2. NO WORK SHOULD BE PERFORMED ON THE UNIT BY PERSONS UNFAMILIAR WITH BASIC SAFETY MEASURES AS DICTATED FOR ALL ELECTRONICS TECHNICIANS IN THEIR LINE OF WORK.
3. WHEN PERFORMING TESTING AS DICTATED WITHIN THIS MANUAL, DO NOT CONNECT THE UNIT TO A POWER SOURCE UNTIL INSTRUCTED TO DO SO. WHEN THE POWER SUPPLY CABLE MUST BE CONNECTED, USE EXTREME CAUTION IN WORKING ON POWER SUPPLY AND OTHER ELECTRONIC COMPONENTS.

WARNING

1. REPAIRS ON EPSON PRODUCT SHOULD BE PERFORMED ONLY BY AN EPSON CERTIFIED REPAIR TECHNICIAN.
2. MAKE CERTAIN THAT THE SOURCE VOLTAGE IS THE SAME AS THE RATED VOLTAGE, LISTED ON THE SERIAL NUMBER/RATING PLATE. IF THE EPSON PRODUCT HAS A PRIMARY-AC RATING DIFFERENT FROM THE AVAILABLE POWER SOURCE, DO NOT CONNECT IT TO THE POWER SOURCE.
3. ALWAYS VERIFY THAT THE EPSON PRODUCT HAS BEEN DISCONNECTED FROM THE POWER SOURCE BEFORE REMOVING OR REPLACING PRINTED CIRCUIT BOARDS AND/OR INDIVIDUAL CHIPS.
4. IN ORDER TO PROTECT SENSITIVE μP CHIPS AND CIRCUITRY, USE STATIC DISCHARGE EQUIPMENT, SUCH AS ANTI-STATIC WRIST STRAPS, WHEN ACCESSING INTERNAL COMPONENTS.
5. REPLACE MALFUNCTIONING COMPONENTS ONLY WITH THOSE COMPONENTS RECOMMENDED BY THE MANUFACTURER; INTRODUCTION OF SECOND-SOURCE ICs OR OTHER NONAPPROVED COMPONENTS MAY DAMAGE THE PRODUCT AND VOID ANY APPLICABLE EPSON WARRANTY.

PREFACE

This manual describes functions, theory of electrical and mechanical operations, maintenance, and repair of the GT-6000.
The instructions and procedures included herein are intended for the experienced repair technician, and attention should be given to the precautions on the preceding page. The chapters are organized as follows:

Chapter 1 – Provides a general product overview, lists specifications, and illustrates the main components of the scanner.

Chapter 2 – Describes the theory of scanner operation.

Chapter 3 – Includes a step-by-step guide for product disassembly and assembly.

Chapter 4 – Includes a step-by-step guide for product adjustment.

Chapter 5 – Provides Epson-approved techniques for troubleshooting.

Chapter 6 – Describes preventive maintenance techniques and lists lubricants and adhesives required to service the equipment.

* The contents of this manual are subject to change without notice.

REVISION TABLE

REVISION	DATE ISSUED	CHANGE DOCUMENT
A	Mar. 7, 1990	1st issue

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CHAPTER 1
GENERAL DESCRIPTION

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1.1 FEATURES

The GT-6000 is a low-cost, high-resolution (300 DPI) color image scanner for use with A4 or letter-size sheets. Its main features are as follows:

1. Basic resolution: 300 DPI
2. Full color scanning: By means of 8-bit A/D converter
3. Monochrome levels: 256
4. Reading areas: A4 and US letter size
5. Low price, high quality
6. Selectable resolution allows use with various printers
7. Zoom function: Scanned image can be reduced/enlarged from 50% to 200%
8. Scanner can perform line-sequence reading (1-time color reading).
9. Scanner offers tone correction levels and various other processing features.
10. Color correction tables are available for various printer types.
11. Scanner is equipped with a high-speed interface.
12. Software command level: ESC/I – B3
13. Interfaces: Two standard interfaces
    - Bi-directional parallel and RS-232C serial
    - Optional interface: SCSI

The GT-6000 is equipped with both a parallel interface and an RS-232C serial interface. The optional SCSI interface allows scanning from an Apple Macintosh computer. Table 1-1 lists the optional units available. Figure 1-1 shows the scanner's external appearance.

Table 1-1. Optional Units

Model	Description
B808011	Bi-directional interface board for IBM PC & compatibles
B806011	EpScan II scanner utility program
B808021	Apple Macintosh SCSI interface kit
B806021	EpScan Mac scanner program
B860061	Apple Macintosh scanner serial interface cable
B860011	Parallel interface cable for direct printing

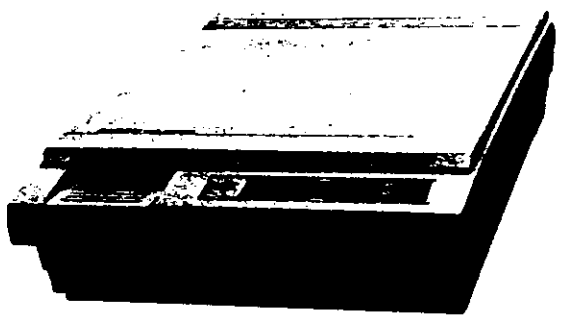


Figure 1-1. Exterior View of the GT-6000

1.2 SPECIFICATIONS

This section describes the specifications for the GT-6000.

1.2.1 General Specifications

Type:	Flat bed color image scanner
Sub-scanning method:	Movement of the reading head
Photoelectric device:	CCD (Charge Coupled Device) line sensor
Manuscript size:	216 × 297 mm (A4 size)
Maximum effective picture elements:	2544 × 3510 pixels at 300 DPI, 100%
Basic resolution:	Main scan: 300 DPI Sub scan: 300 DPI
Command selectable resolutions:	600, 480, 400, 360, 320, 300, 240, 200, 180, 150, 144, 120, 100, 90, 80, 75, 72, 50 (selectable by software command)
Scanning speeds:	Monochrome: typ. 6.5 m sec/line Color (page sequence): typ. 10 m sec/line Color (line sequence): typ. 35 m sec/line
Color separation:	By light source 3 colors: Green, Red, Blue
Reading sequence:	Page sequence
Color:	3-time scanning (G → R → B) Line sequence 1-time scanning
Monochrome:	1-time scanning (Selectable drop-out color: G, R, or B)
Zooming:	50% to 200%, by 1% step Selected by software command Horizontal and vertical zooming are independent
Halftoning:	8 bits per pixel for each color
Brightness:	7 levels Selectable by panel switch or software command
Image data:	1 to 8 bits per pixel, selectable
Digital halftoning:	
bi-level	Mode A, B, C, or None
quad-level	Mode A or None
Tone correction:	CRT1, CRT2 Printer A, B, C
Color correction:	Impact-dot, Thermal, Ink-jet printer Color CRT display
Direct printing:	ESC/P24-83C (24-dot with color) HP Paint-Jet
Interfaces:	RS-232C serial,
Standard interfaces:	Bi-directional parallel
Optional interface:	SCSI
Light source:	Noble gas fluorescent lamps
Safety regulations:	UL/CSA TUV etc.

1.2.2 Electrical Specifications

Supply voltage:	120 VAC +/− 10%
	220 VAC +/− 10% ←
	240 VAC +/− 10%
	non-switchable
Frequency:	49.5 to 60.5 Hz
Power consumption:	MAX 40 W
Insulation resistance:	20 M ohms at 500 VDC
	between AC power line and chassis
Radiation noise:	FTZ FCC Class B

1.2.3 Resistance electricity

Static electricity:	panel – 10 KV
	metal – 7KV, 150 pF, 150 ohms

1.2.4 Environmental Conditions

Temperature:	Operating:	5 to 35 degrees C
	Storage:	−25 to 60 degrees C
Humidity:	Operating:	10 to 80%, no condensation
	Storage:	10 to 85%, no condensation

1.2.5 Reliability

Main unit: MCBF 100,000 cycle (1 cycle = ACC → [illegible])

1.2.6 Operating Conditions

Dust:	Ordinary office or home conditions
	Extreme dust should be avoided.
Illumination:	Do not operate under direct sunlight or near strong light source. (Reliability under such circumstances cannot be uaranteed.)

1.2.7 Manuscripts

Refractive type

Documents with smooth surfaces (such as printing and photographs)

1.2.8 Manuscript Table

Dimensions 216 mm (Horizontal) × 297 mm (Vertical)

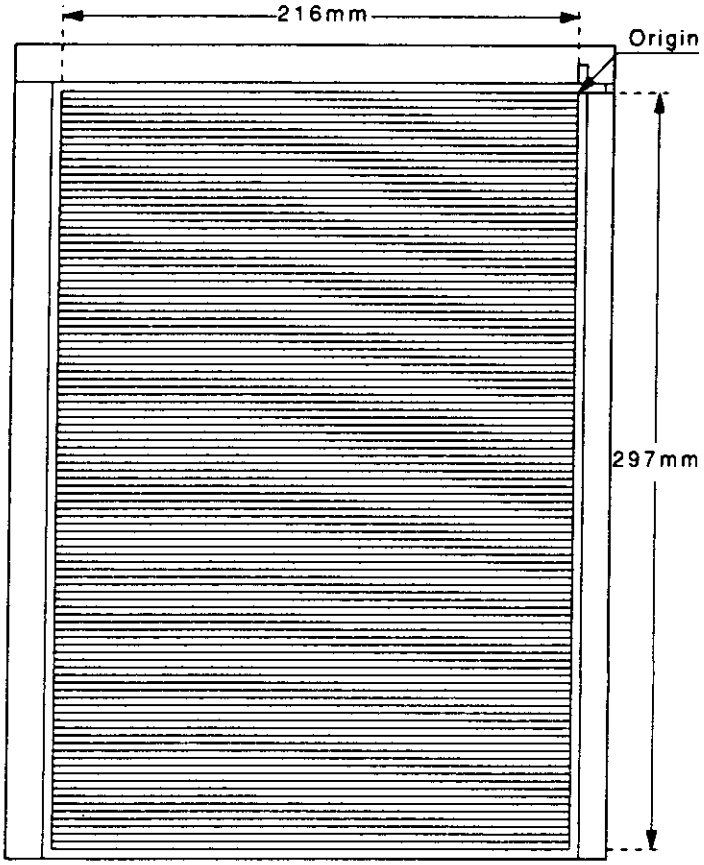


Figure 1-2. Manuscript Table

1.2.9 Physical Dimensions And Weight

Dimensions: 320 mm × 510 mm × 123 mm (W × D × H)
Weight: Approx. 9 kg

1.3 INTERFACE SPECIFICATIONS

This scanner comes standard with a bi-directional parallel interface and an RS-232C serial interface. This section describes the interface specifications.

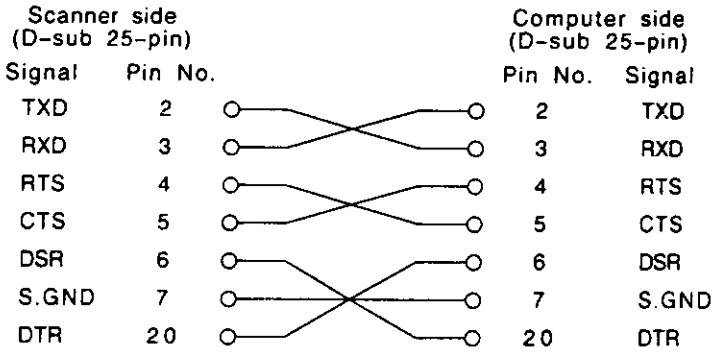
1.3.1 RS-232C Serial Interface

The specifications for the serial interface are as follows:

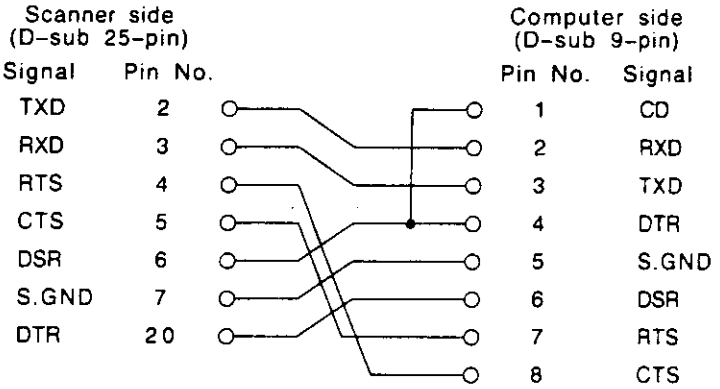
Transfer method:	RS-232C compatible, asynchronous	
Transfer rate:	300, 600, 1200, 2400, 4800, 9600 and 19200 bps	
	Selected by DIP switch	
Data format:	Data length:	8 bits
	Start bit:	1 bit
	Stop bit:	1 bit or 2 bits
		Selectable
	Parity bit:	Odd, Even, or None
		Selectable
Handshaking:	ACK/NACK handshaking	
Signal voltage:	Logic "1" MARK −3 to −27 V	
	Logic "0" SPACE 3 to 27 V	
Connector type:	25-pin, DB-295A-J4(JAE) compatible	
Connector pin assignments:	See Table 1-2.	

Table 1-2. Connector Pin Assignments

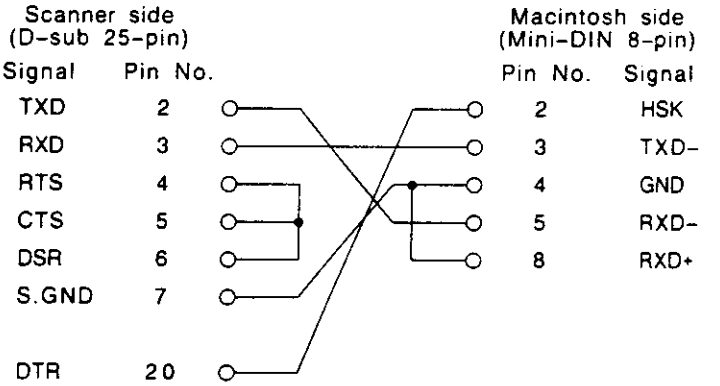
Pin No.	Signal Name	I/O	Description
1	FG	—	Frame ground
2	TXD	O	Transmit data
3	RXD	I	Receive data
4	RTS	O	Request to send
5	CTS	I	Clear to send
6	DSR	I	Data set ready
7	SG	—	Signal ground
8 to 19	NC		Not used
20	DTR	O	Data terminal ready
21 to 25	NC		Not used



(For IBM PC, PC/XT, and PS/2)



(For IBM PC/AT)



(For Apple Macintosh)

Figure 1-3. Interface Signal Connection

1.3.2 Bi-directional Parallel Interface

The specifications for the bi-directional parallel interface are as follows:

Interface type:	Bi-directional parallel interface
Data format:	8 bit parallel
Synchronization:	By $\overline{\text{STROBE}}$ pulse
Handshaking:	By $\overline{\text{ACKNLG}}$ pulse
Logic level:	Input/output data and interface control signals are TTL level compatible.
Connector type:	57-30360 (AMPHENOLL) or equivalent
Data transmission timing:	See Figures 1-4 and 1-5.
Pin assignments:	See Table 1-3.

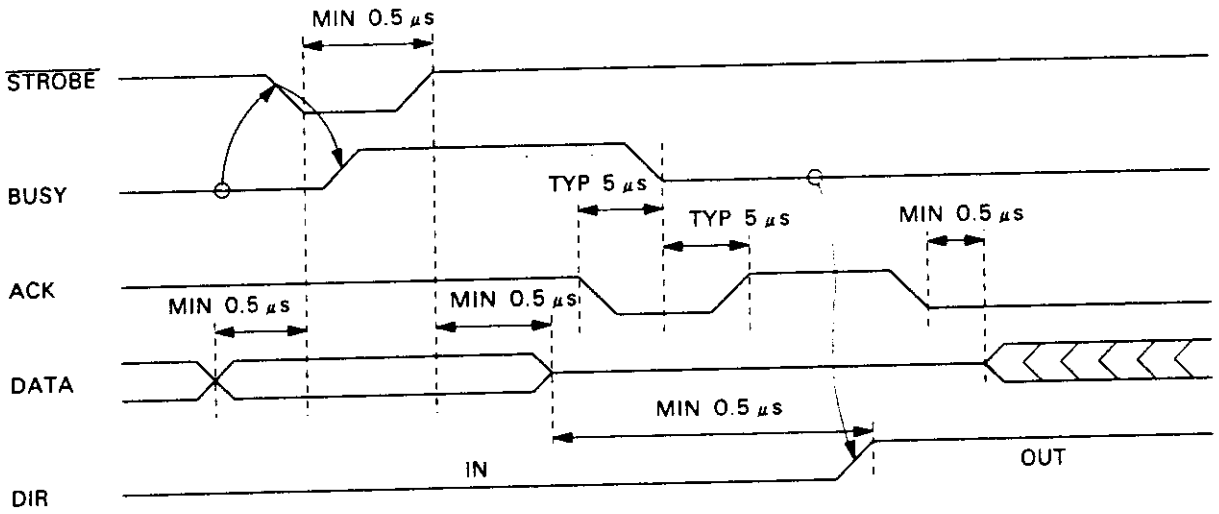


Figure 1-4. Data Transmission Timing (Host to Scanner)

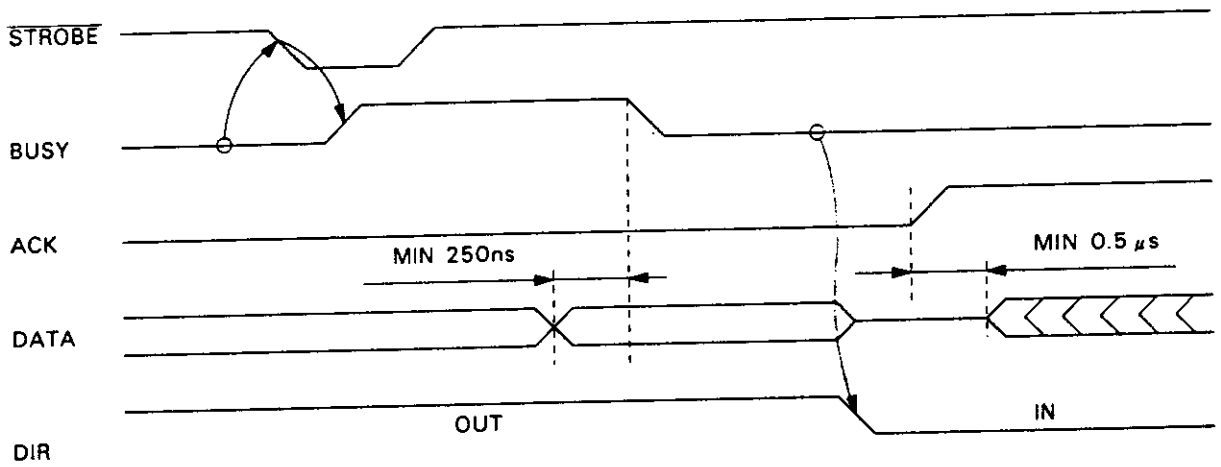


Figure 1-5. Data Transmission Timing (Scanner to Host)

Table 1-3. Pin Assignments

Pin No.	Return Pin	Signal	I/O	Description
1	19	$\overline{\text{STROBE}}$	I/(O)	$\overline{\text{STROBE}}$ pulse to read in or send out data. Pulse width at receiving terminal must exceed 0.5 microseconds.
2-9	20-27	DATA 0-7	I/O	These signals convey the 1st to 8th bits of data. High level indicates logical 1, Low level indicates logical 0.
10	28	$\overline{\text{ACKNLG}}$	O/(I)	Pulse of approx. 12 microseconds. Low level indicates that data have been received and the scanner is ready to accept more data.
11	29	BUSY	O/(I)	When this signal is High, the scanner cannot receive data. The signal becomes High: 1) during data entry, 2) during scanning, 3) when the scanner is not ready, 4) during scanner error.
12-15	—	NC	—	Not used
16	—	GND	—	Logic ground level
17	—	C-GND	—	Scanner chassis ground
18	—	NC	—	Not used
19-30	—	GND	—	Twisted-pair return signal ground level
31	—	$\overline{\text{INIT}}$	I	When this signal level becomes Low, the scanner is reset to its power-on state. This level is usually High. The pulse width at the receiving terminal must be greater than 50 microseconds.
32	—	NC	—	Not used
33	—	GND	—	Twisted-pair return signal ground level
34-35	—	NC	—	Not used
36	—	DIR	I	Low indicates that direction is input.

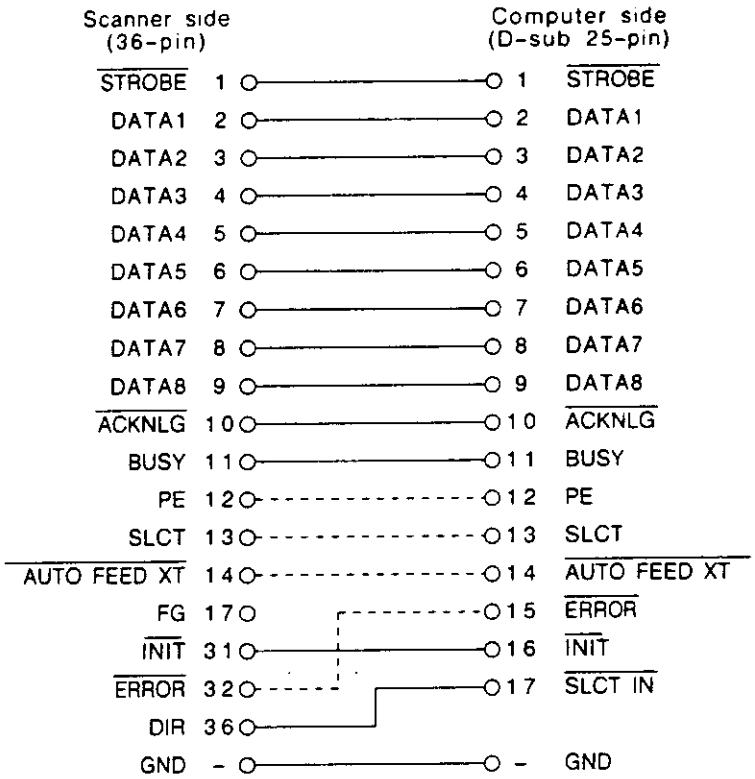


Figure 1-6. Interface Signal Connections for IBM PC, PC/XT, PC/AT, and PS/2

1.4 SWITCHES AND INDICATORS

This section describes the GT-6000's switches and indicators.

Switches

Power switch: Turns the scanner on or off. The scanner resets when power is switched on.

ZOOM/BRIGHT switch (Z/B): Selects function of %LED segment and +/− switches.

+/− switch:
Zoom mode: Sets the zooming value.
(+) switch increment
(−) switch decrement
Bright mode: Set the brightness value (in 7 steps)
(+) switch lighter
(−) switch darker

NOTE: Software settings have priority over switch settings.

PRINT switch: When the scanner is directly connected to a printer, this switch sends control codes and image data to the printer. (This switch is selected by simultaneously pressing the (−) and (Z/B) switches.)

NOTE: The PRINT switch functions only when DIP switches 2-8 is ON.

Indicators

POWER (Green LED): Indicates that power is ON

READY (Green LED): Comes on when the scanner is ready to receive data. Flashes in combination with the ERROR light when an error occurs.

BRIGHT (Orange LED): Indicates that %LED segments and +/− switches are in bright mode

ZOOM (Orange LED): Indicates that %LED segments and +/− switches are in zoom mode

%LED segment (Green): Indicates the current zoom value.
(50 to 200)
Indicates the current selected brightness value.
<dark> −3 to 3 <light>
When error occurs, indicates error code.
(Refer to Section 1.8.)

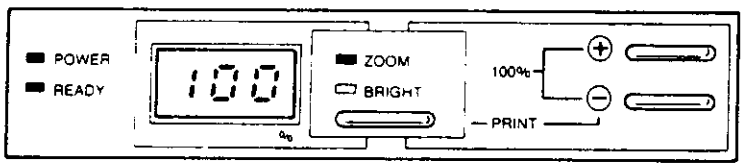


Figure 1-7. Control Panel

1.5 DIP SWITCH SETTINGS

This section describes the DIP switch settings for the GT-6000. The scanner's two DIP-switch panels are located inside the DIP switch cover. Tables 1-4 through 1-10 indicate switch functions. DIP-switch status is read only at power on or when an $\overline{INIT}$ signal is received.

Table 1-4. DIP Switch Panel 1 (SW1)

Switch No.	Description	ON	OFF	Factory Setting
1-1	Baud selection	See Table 1-5 below		ON
1-2				OFF
1-3				OFF
1-4	Stop bit selection	2 bit	1 bit	ON
1-5	Parity bit selection	Even parity	Odd parity	OFF
1-6	Parity check selection	Enable	Disable	OFF
1-7	Printer selection (for direct-print)	See Table 1-6, below		OFF
1-8				OFF

Table 1-5. Baud Selection

1-3	1-2	1-1	Baud
OFF	OFF	OFF	19200
OFF	OFF	ON	9600
OFF	ON	OFF	4800
OFF	ON	ON	2400
ON	OFF	OFF	1200
ON	OFF	ON	600
ON	ON	OFF	300

Table 1-6. Printer Selection

1-8	1-7	Printer
OFF	OFF	ESC/P24-83C (80 Columns)
OFF	ON	Not used
ON	OFF	Paint-Jet (HP)
ON	ON	ESC/P24-83C (136 Columns)

Table 1-7. DIP Switch Panel 2 (SW2)

Switch No.	Description	ON	OFF	Factory Settings
2-1	Set digital halftoning	See Table 1-8 below		ON
2-2				OFF
2-3	Set gamma correction	See Table 1-9 below		OFF
2-4				OFF
2-5				OFF
2-6	Set color correction	See Table 1-10 below		ON
2-7				ON
2-8	Parallel I/F (*1)	Uni-d	Bi-d	OFF

*1: SW 2-8 should be set ON only for direct printing.
Uni-d: Uni-directional (direct printing)
Bi-d : Bi-directional

Table 1-8. Set Digital Halftoning

2-2	2-1	Set Digital Halftoning
OFF	OFF	Bi-level
OFF	ON	Half-tone A
ON	OFF	Half-tone B
ON	ON	Half-tone C

Table 1-9. Set Gamma Correction

2-5	2-4	2-3	Set Gamma Correction
OFF	OFF	OFF	CRT 1
OFF	OFF	ON	CRT 2
OFF	ON	OFF	Printer A
OFF	ON	ON	Printer B
ON	OFF	OFF	Printer C

Table 1-10. Set Color Correction

2-7	2-6	Set Color Correction
OFF	OFF	Impact-dot printer
OFF	ON	Thermal printer
ON	OFF	Ink-jet printer
ON	ON	Monitor (CRT)

1.6 SELF TEST

This scanner provides two self-test modes (page sequence and line sequence). Self-testing confirms that mechanical and electrical operation is in order. Because the scanner does not send image data during the self-test, you can perform the self-test without connecting the scanner to a computer. If the self-test discovers a problem,the % LED segment displays the corresponding error code. (Refer to Section 1.8.)

To begin the self test in page sequence reading mode, turn the scanner ON while pressing the (+) button. The scanner performs the page sequence reading as follows:

Scanner initialization (green, red, blue lamp flash in turn)

⬇

Green reading, then return to home position

⬇

Red reading, then return to home position

⬇

Blue reading, then return to home position

To begin the self test in line sequence reading mode, turn the scanner ON while pressing the (−) button. The scanner performs the line sequence reading as follows:

Scanner initialization (green, red, blue lamps flash in turn)

⬇

Read head moves from the home position to end
(Green, red, and blue lamp flash in turn)

When the self test completes, the lamps go out and the READY LED on the control panel comes on. To terminate a self-test prior to completion, turn the power off (using the power switch).

1.7 ROM VERSION INDICATION

The scanner can display the ROM version on the control panel's % LED segment. To generate this display, switch the power on while pressing both the ZOOM/BRIGHT switch and the (−) switch.

1.8 ERRORS

When an error occurs, the scanner displays the corresponding error message in the control panel's %LED segment.

COMMAND Error

Cause:	Unidentified command or incorrect parameter was detected.
Handling:	The scanner ignores the command or parameter. (The received command or the current settings are effective.) The scanner sends NACK and awaits the next command or parameter.
Indications:	READY LED comes ON. E-C
Correction:	The error condition clears when the scanner receives the next command.

INTERFACE Error

Cause:	Incorrect communication parameter received. Broken connection (unplugged connector or broken wire). Host fails to respond within 30 seconds. Host is not accepting data (DSR=Low).
Handling:	The lamp goes OFF and the scanner stops operating.
Indications:	READY LED goes OFF. E-I
Correction:	Turn the scanner off, then on.

FATAL Error

Cause:	The lamp is broken. Power was switched on before transportation screws were removed. System breakdown.
Handling:	The lamp goes off and the scanner stops operating. Bit 7 of the status byte is set.
Indications:	READY LED goes OFF. E-F
Correction:	Turn the scanner off and then back on.

1.9 PRINTING FUNCTION

If the scanner is directly connected to a printer, the scanner can send control codes and scanned-image data to the printer. You can use this function to emulate a simple color copier.

Operation:

1. Connect the scanner and printer through their respective parallel interfaces. Use shielded cable for the connection (EPSON B860011 is recommended).
2. Set the DIP switches as follows:

Table 1-11. DIP Switch Setting for Direct Printing

DIP SW	2-8	2-7	2-6	2-5	2-4	2-3	1-8	1-7
ESC/P24 Impact-dot (80 column)	ON	OFF	OFF	OFF	ON	OFF	OFF	OFF
ESC/P24 Thermal (80 column)	ON	OFF	ON	OFF	ON	OFF	OFF	OFF
Paint-jet	ON	ON	OFF	OFF	ON	ON	ON	OFF
ESC/P24 (136 column)	ON	OFF	OFF	OFF	ON	OFF	ON	ON

3. Set the document in the scanner and put paper in the printer. Adjust brightness and zoom as desired.
4. Press the PRINT switch (that is, simultaneously press the (−) and BRIGHT/ZOOM switches).

Specifications:

Printing mode:	Color printing	
Panel DIP SW:	Available	
Interface:	Parallel	
Printing size:	ESC/P24 (80 columns)	200 × 237 mm
	Paint-jet (HP)	200 × 237 mm
	ESC/P24 (136 columns)	246 × 301 mm

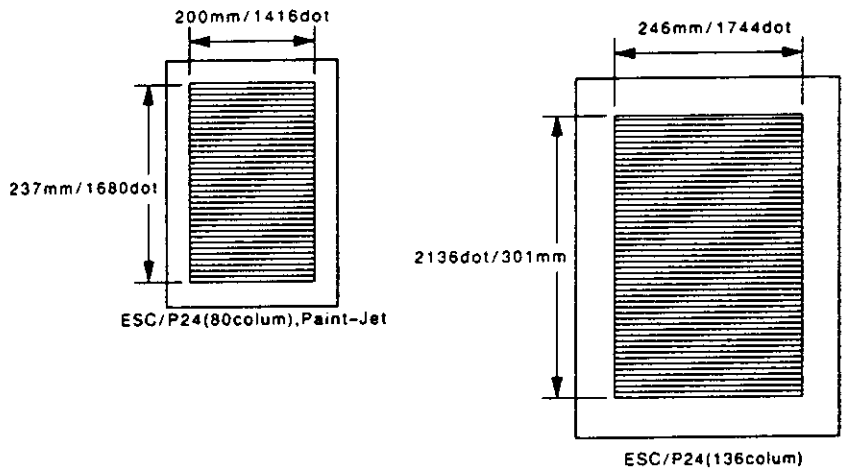


Figure 1-8. Printing Size

1.10 DATA TRANSMISSION PROTOCOL

This section describes the data transmission protocol used by the scanner and host computer.

1.10.1 Control Code Handshaking

This section describes the control code handshaking procedure.

<Control Codes with No Parameters>

Step 1 Control code from host computer

Step 2 Response from scanner

ACK (06H): Legal control code received
(The scanner accepts the control code.)

NACK (15H): Illegal control code received.
(The scanner does not accept the control code.)

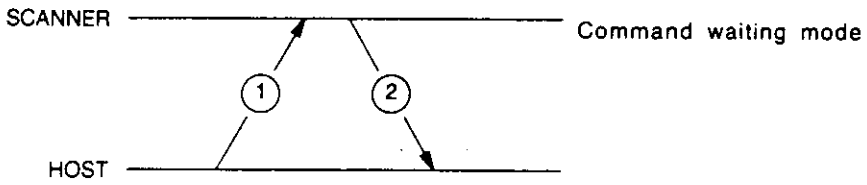


Figure 1-9. Control Codes with No Parameters

<Control Codes with Parameters>

Step 1 Control code from host computer

Step 2 Response from the scanner

ACK (06H): Legal control code received
(The scanner accepts the control code.)

NACK (15H): Illegal control code received
(The scanner does not accept the control code.)

Step 3 When the host receives ACK, it sends the parameters.

Step 4 Response from the scanner

ACK (06H): Legal parameters received
(The scanner accepts the parameters.)

NACK (15H): Illegal parameters received
(The scanner does not accept the parameters.)

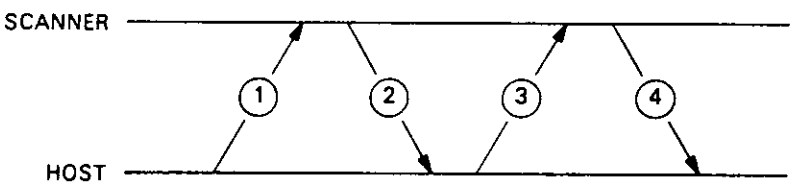


Figure 1-10. Control Codes with Parameters

1.10.2 Data-Block Handshaking Procedure

This section describes the data-block handshaking procedure.

<Scanner Data Request or Monochrome Reading>

The following handshaking procedure is used for control codes which request data-return from the scanner.

Step 1 Control code from host computer

Step 2 Data-block from scanner

Step 3 Response from host computer

ACK (06H): Continue, send next data

CAN (18H): Abort

Step 4 Scanner sends final data-block.

NOTE: The host computer should not return ACK(06H) after receiving the final data-block.

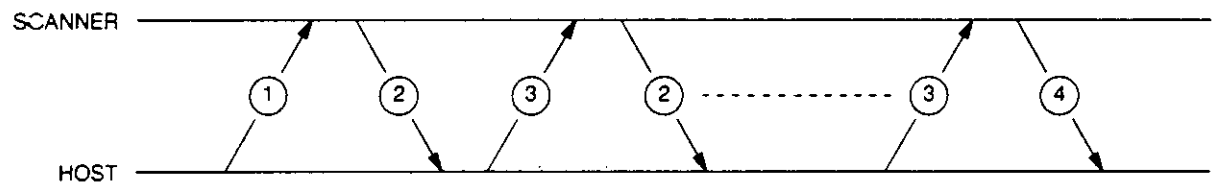


Figure 1-11. Scanner Data Request and Monochrome Reading

<Page Sequence Mode Color Reading>

Step 1 Control code from host computer

Step 2 Data-block from scanner

Step 3 Response from host computer

ACK (06H): Continue. send next data

CAN (18H): Abort

Step 4 Scanner sends final data-block.

NOTE: The host computer should not return ACK (06H) after receiving the final data-block.

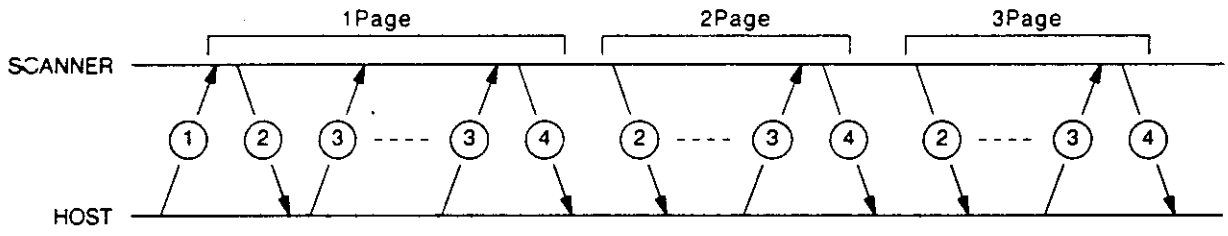


Figure 1-12. Color Reading (Page Sequence Mode)

<Line Sequence Mode Color Reading>

Step 1 Control code from host computer
Step 2 Data-block (green) from scanner
Step 3 Data-block (red) from scanner
Step 4 Data-block (blue) from scanner
Step 5 Response from host computer
ACK (06H): Continue, send next data
CAN (18H): Abort
Step 6 Scanner sends final data-block.

NOTE: The host computer should not return ACK (06H) after receiving the final data-block.

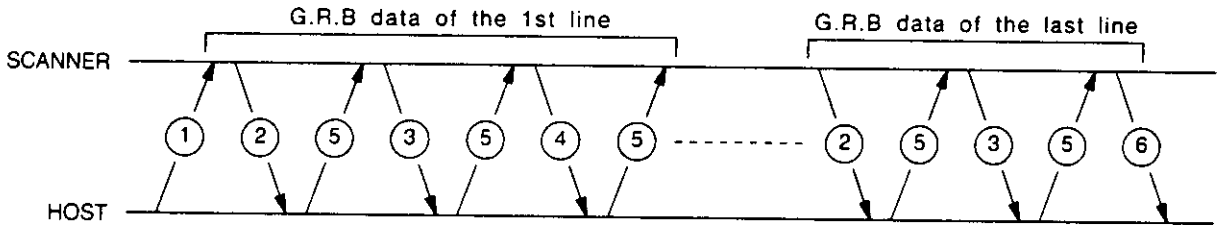


Figure 1-13. Color Reading (Line Sequence Mode)

1.10.3 Data-Block Format

The section describes the data-block format.
If only the information block is to be sent to the host computer, the byte counter is set to 0000H.

<Information Block>

(1) Header: STX code (02H)
One byte at the beginning of each data-block.
Notifies the host computer that the data is a data-block.
(2) Status: Refer to Section 1.10.4
(3) Byte Counter: A two-byte parameter indicating the total amount of data in the block.
The low-order byte precedes the high-order byte.

<Data>

Consists of scanner ID, image data, etc.
In most cases, a single data-block covers one main image scan.

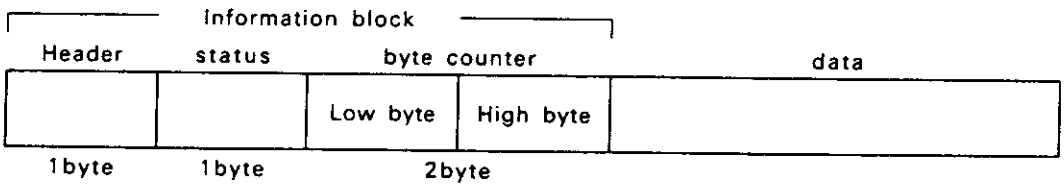


Figure 1-14. Data-Block Format

1.10.4 Format of Status Byte

(1) Status indicates the current condition and error status of the scanner.
(2) Status accompanies the data block's information block.
(3) Status is returned to the host computer if the computer has issued a status request command (ESC F).

Meaning of each status bit

Bit 7: Fatal error flag
Set when a system error occurs.

Bit 6: BUSY/READY.
Set when BUSY.
* To abort data transmission while the scanner is reading, set this to 1. To resume transmission, reset to 0.

Bit 5: Area end flag
a. For color reading, set to 1 for the last data-block of a color's page.
b. For monochrome reading, set to 1 for the last data-block of the page.

Bit 4: (reserved) Always 0

Bit 3: Color attribute 1. See Table 1-12, below.

Bit 2: Color attribute 2. See Table 1-12, below.

Bit 1: (reserved) Always 0

Bit 0: (reserved) Always 0

Table 1-12. Color Attribute

Bit		3	2
Monochrome mode (ECS C 0)		0	0
Color mode (ESC C 1)	Green	0	1
	Red	1	0
	Blue	1	1

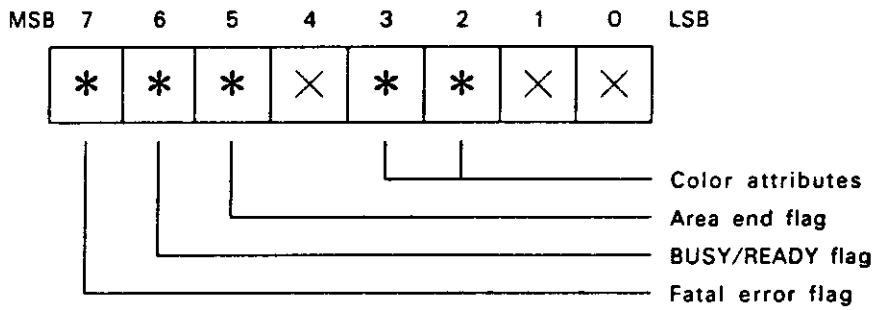


Figure 1-15. Status Byte

1.11 SCANNER FUNCTIONS

Table 1-13 summarizes the scanner's functions and settings. These functions are explained on the following pages. The functions are all controlled by software commands. A number of them may also be set using the control panel or DIP switches.

Table 1-13. Scanner Functions

Function	Available Settings
Output Resolution	19 settings, from 50 to 600 DPI
Zoom	50% to 200%, in 1% steps
Read Area	Offset and reading length
Data Format	1 to 8 bits per pixel per color
Color Mode	Color line sequence mode, color page sequence mode, monochrome mode
Brightness	Seven levels
Halftoning Mode	3 modes
Gamma Correction	5 settings for output devices
Color Correction	4 settings for output devices

1.11.1 Output Resolution

The output resolution determines how many pixels (dots) are used to scan and reproduce the image. Resolution is measured in DPI (dots per inch). You can set main scan an sub-scan resolutions independently. As resolution increases, the image is read and reproduced in finer detail. When both main scan and sub-scan are set to 300 DPI, a one-inch square image is represented by 90,000 dots.

You should normally choose a setting that matches the resolution of the printer. The scanner offers 19 different resolution settings, so that optimal resolution can be selected for most types of printers. The 19 resolution settings (in DPI) are: 50, 72, 75, 80, 90, 100, 120, 144, 150, 160, 180, 200, 240, 300, 320, 360, 400, 480, and 600.

Most printers offer several resolution settings, and horizontal and vertical values may differ. The software settings you use for printing determine which resolution settings are best. To obtain the best image, set the resolution so that it conforms with your printer software settings.
The following guidelines may help you find an appropriate resolution for the output device you are using.

Resolution	Output Device
• 70 to 80 DPI	CRT displays (around 0.3 mm pitch)
• 72, 90, 144 DPI	9-pin dot matrix printers
• 90, 120, 180, 360 DPI	24-pin dot matrix printers
• 75, 150,300, 600 DPI	Page printers
• 100, 200, 300, 400 DPI	Facsimile transmission

The ESC R command sets the output resolution. The default resolution is 100 DPI (for both main scan and sub scan).

1.11.2 Zoom

You can use the zoom function to reduce or enlarge the size of the output image. The reduction/enlargement ratio can be set to any value between 50% and 200%, in 1% increments. Values for main scan and sub-scan can be set independently.

The zoom values determine the vertical and horizontal lengths of the image. If the zoom is set to 100%, the image is scanned at actual size. If the zoom is set to 200% for both main scan and sub-scan, the image is magnified to four times the original size. If the zoom is set to 50% for both main-scan and sub-scan, the image is reduced to one-fourth its original size.

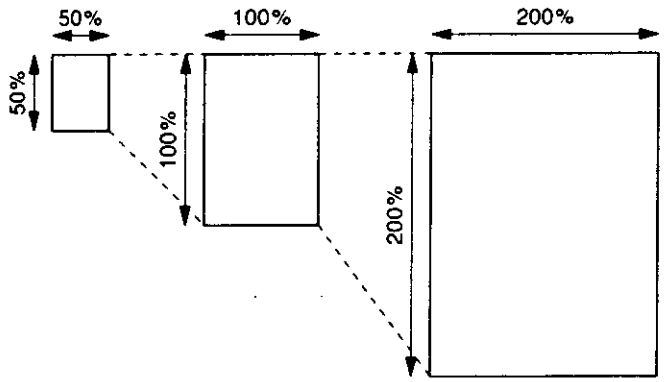


Figure 1-16. Zoom

The zoom function affects the number of scanning dots. An image scanned at 180 DPI and 200% will have the same number of dots as the same image scanned at 360 DPI and 100%. If the image scanned at 180 DPI and 200% is then printed on a 180 DPI printer, the image will be enlarged 200%.

Use the zoom function to perform the major part of the reduction/enlargement for use with application software. Use the application software only for fine adjustments. In particular, quality may deteriorate if you use an application to change an image size scanned in halftoning mode; this practice should therefore be avoided.

The zoom function is set by the ESC H command. The default setting is 100% (for both main scan and sub-scan). You can also set the zoom value directly at the control panel. The current zoom value is displayed on the %LED segment.

1.11.3 Reading Area

This function allows you to limit the scan to a specified portion of the document.
You set the reading area by specifying the reading lengths, in units of dots, for both the main scan and the sub-scan.

The maximum selectable reading area is determined by the resolution and zoom settings. To specify a smaller reading area, indicate the rectangular area and offset from the origin. The smaller area must lie within the maximum selectable area. The following Figure shows the image as viewed from the scanner.

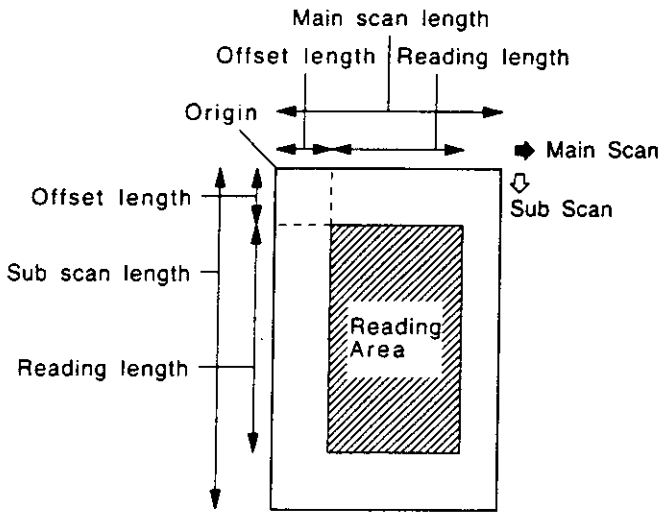


Figure 1-17. Reading Area

The reading area is set by the ESC A command.

At 300 DPI and 100% zoom, the scanner can read ~~2552~~ 2544 by ~~3508~~ 3510 dots, which is equivalent to 216 by 297 mm (8.5 by 11.7 inches). You can specify a reading length of up to 4096 dots for the main scan. The following tables show the maximum reading areas in dots (main scan length by sub-scan length) for typical combinations of output resolution and zoom.

Table 1-14. Zoom and Dot Areas

Zoom (%)	50 DPI	72 DPI	75 DPI	80 DPI
50	208 × 292	304 × 421	312 × 438	336 × 468
60	248 × 351	360 × 505	376 × 526	408 × 561
70	296 × 409	424 × 589	440 × 614	472 × 655
80	336 × 468	488 × 673	504 × 702	544 × 748
90	376 × 526	544 × 758	568 × 789	608 × 842
100	424 × 585	608 × 842	632 × 877	680 × 936
110	464 × 643	672 × 926	696 × 965	744 × 1029
120	504 × 702	728 × 1010	760 × 1053	816 × 1123
130	552 × 760	792 × 1095	824 × 1140	880 × 1216
140	592 × 819	856 × 1179	888 × 1228	952 × 1310
150	632 × 877	912 × 1236	952 × 1316	1016 × 1404
160	680 × 936	976 × 1347	1016 × 1404	1088 × 1497
170	720 × 994	1040 × 1432	1080 × 1491	1152 × 1591
180	760 × 1053	1096 × 1516	1144 × 1579	1224 × 1684
190	800 × 1111	1160 × 1600	1208 × 1667	1288 × 1778
200	848 × 1170	1224 × 1684	1272 × 1755	1360 × 1872

Table 1-14. Zoom and Dot Areas (Continued)

Zoom (%)	90 DPI	100 DPI	120 DPI	144 DPI
50	376 × 526	424 × 585	504 × 702	608 × 842
60	456 × 631	504 × 702	608 × 842	728 × 1010
70	528 × 737	592 × 819	712 × 982	856 × 1179
80	608 × 842	680 × 936	816 × 1123	976 × 1347
90	688 × 947	760 × 1053	912 × 1263	1096 × 1516
100	760 × 1053	848 × 1170	1016 × 1404	1224 × 1684
110	840 × 1158	928 × 1287	1120 × 1544	1344 × 1853
120	912 × 1263	1016 × 1404	1224 × 1684	1464 × 2021
130	992 × 1368	1104 × 1521	1320 × 1825	1584 × 2190
140	1064 × 1474	1184 × 1638	1424 × 1965	1712 × 2358
150	1144 × 1579	1272 × 1755	1528 × 2106	1832 × 2527
160	1224 × 1684	1360 × 1872	1632 × 2246	1952 × 2695
170	1296 × 1790	1440 × 1989	1728 × 2386	2080 × 2864
180	1376 × 1895	1528 × 2106	1832 × 2527	2200 × 3032
190	1448 × 2000	1608 × 2223	1936 × 2667	2320 × 3201
200	1528 × 2106	1696 × 2340	2040 × 2808	2448 × 3369

Table 1-14. Zoom and Dot Areas (Continued)

Zoom (%)	150 DPI	160 DPI	180 DPI	200 DPI
50	632 × 877	680 × 936	760 × 1053	848 × 1170
60	760 × 1053	816 × 1123	912 × 1236	1016 × 1404
70	888 × 1228	952 × 1310	1064 × 1474	1184 × 1638
80	1016 × 1404	1088 × 1497	1224 × 1684	1360 × 1872
90	1144 × 1579	1224 × 1684	1376 × 1895	1528 × 2106
100	1272 × 1755	1360 × 1872	1528 × 2106	1696 × 2340
110	1400 × 1930	1496 × 2059	1680 × 2316	1864 × 2574
120	1528 × 2106	1632 × 2246	1832 × 2527	2040 × 2808
130	1656 × 2281	1768 × 2433	1984 × 2737	2208 × 3042
140	1784 × 2457	1904 × 2620	2136 × 2948	2376 × 3276
150	1912 × 2632	2040 × 2808	2288 × 3159	2544 × 3510
160	2040 × 2808	2176 × 2995	2448 × 3369	2720 × 3744
170	2160 × 2983	2312 × 3182	2600 × 3580	2888 × 3978
180	2288 × 3159	2448 × 3369	2752 × 3790	3056 × 4212
190	2416 × 3334	2584 × 3556	2904 × 4001	3224 × 4446
200	2544 × 3510	2720 × 3744	3056 × 4212	3400 × 4680

Table 1-14. Zoom and Dot Areas (Continued)

Zoom (%)	240 DPI	300 DPI	320 DPI	360 DPI
50	1016 × 1404	1272 × 1755	1360 × 1872	1528 × 2106
60	1224 × 1684	1528 × 2106	1632 × 2246	1832 × 2527
70	1424 × 1965	1784 × 2457	1904 × 2620	2136 × 2984
80	1632 × 2246	2040 × 2808	2176 × 2995	2448 × 3369
90	1832 × 2527	2288 × 3159	2448 × 3369	2752 × 3790
100	2040 × 2808	2544 × 3510	2720 × 3744	3056 × 4212
110	2240 × 3088	2800 × 3861	2992 × 4118	3360 × 4633
120	2448 × 3369	3056 × 4212	3264 × 4492	3672 × 5054
130	2648 × 3650	3312 × 4563	3536 × 4867	3976 × 5475
140	2856 × 3931	3568 × 4914	3808 × 5241	4280 × 5896
150	3056 × 4212	3824 × 5265	4080 × 5616	4584 × 6318
160	3264 × 4492	4080 × 5616	4352 × 5990	4896 × 6739
170	3464 × 4773	4328 × 5967	4624 × 6364	5200 × 7160
180	3672 × 5054	4584 × 6318	4896 × 6739	5504 × 7581
190	3872 × 5335	4840 × 6669	5168 × 7113	5808 × 8002
200	4080 × 5616	5096 × 7020	5440 × 7488	6120 × 8424

Table 1-14. Zoom and Dot Areas (Continued)

Zoom (%)	400 DPI	480 DPI	600 DPI
50	1696 × 2340	2040 × 2808	2544 × 3510
60	2040 × 2808	2448 × 3369	3056 × 4212
70	2376 × 3276	2856 × 3931	3568 × 4914
80	2720 × 3744	3264 × 4492	4080 × 5616
90	3056 × 4212	3672 × 5054	4584 × 6318
100	3400 × 4680	4080 × 5616	5096 × 7020
110	3736 × 5148	4488 × 6177	5608 × 7722
120	4080 × 5616	4896 × 6739	6120 × 8424
130	4416 × 6084	5304 × 7300	6624 × 9126
140	4760 × 6552	5712 × 7826	7136 × 9828
150	5096 × 7020	6120 × 8424	7648 × 10530
160	5440 × 7488	6528 × 8985	8160 × 11232
170	5776 × 7956	6936 × 9547	8864 × 11934
180	6210 × 8424	7344 × 10108	9176 × 12636
190	6456 × 8892	7752 × 10670	9688 × 13338
200	6800 × 9360	8160 × 11232	10200 × 14040

NOTE: The maximum main scan reading length is 4096 dots.

1.11.4 Data Format

The data format specifies the number of bits (from 1 to 8) used to represent the tone of each pixel. Larger values enable a greater variety of tones or colors.

In monochrome mode, a format setting of 1 bit/pixel (bi-level data) provides only two tones: black (0) and white (1). A setting of 2 bits/pixel (quad-level data) shows four tone levels (corresponding to binary values 00, 01, 10 and 11). Eight bits/pixel provides for 256 shades of gray, generating a result that has photographic quality.

When used with color mode, the data format defines the number of tones for each primary color (green, red, and blue). A setting of 1 bit/pixel allows for eight colors (2 × 2 × 2); 2 bits/pixel can represent 64 colors (4 × 4 × 4). Eight bits/pixel (providing a total of 24 bits for each pixel) can represent more than 16 million different colors.

Table 1-15. Data Format

Data Format	Monochrome	Color
1 bit/pixel	2 grays	8 colors
2 bits/pixel	4 grays	64 colors
3 bits/pixel	8 grays	512 colors
4 bits/pixel	16 grays	4,096 colors
5 bits/pixel	32 grays	32,768 colors
6 bits/pixel	64 grays	262,144 colors
7 bits/pixel	128 grays	2,097,152 colors
8 bits/pixel	256 grays	16,777,216 colors

If you want to reproduce images using more than 2 bits/pixel, you should use an output device capable of supporting the resulting tonalities. Most microcomputer displays and printers cannot support such tonalities. To achieve optimal results with these devices, you should normally use a 1 bit/pixel format together with halftoning mode.

The ESC D command sets the data format.

1.11.5 Brightness

The scanner enables you to choose one of seven different brightness levels for scanning. The central setting is the normal one.

Darker settings are appropriate for line art and for faint original images; lighter settings should be used when the original image is dark. Brightness can be set independently of other functions.

The following graph shows the differences between brightness settings when the gamma correction is set to CRT display A.

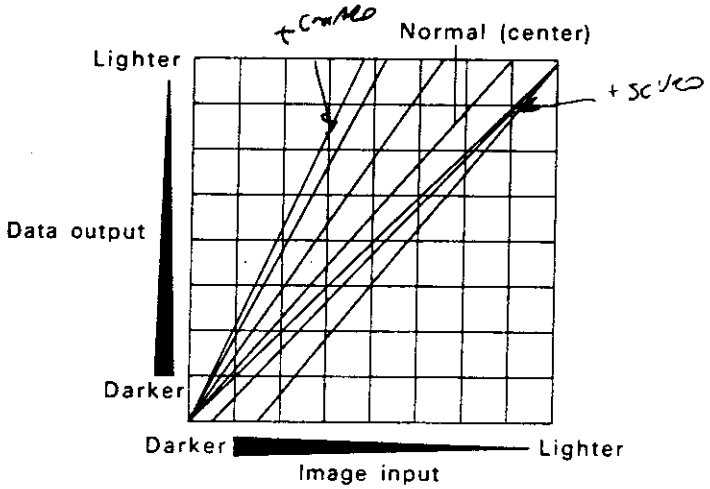


Figure 1-18. Brightness

The ESC L command selects the brightness. You can also set the zoom value directly at the control panel. You can display the current setting on the % LED segment.

1.11.6 Color Mode

The color mode indicates whether the scanner performs color or monochrome reading. When you use color reading, you may further select between page sequence reading and line sequence reading. For monochrome reading, you can select the dropout color (red, green, or blue).

Color page sequence reading

The scanner scans the entire document three times, once for each primary color (green, red, blue), producing three pages of image data. The pages can then be added to produce a full color image. This type of processing is advantageous for computers having limited storage capacity or processing speed. Page sequence reading is faster than line sequence reading.

Color line sequence reading

The scanner simultaneously scans red, green, and blue for each line of the document. Compared to page sequence reading, line sequence reading provides more accurate color separation. In addition, because pixel colors are determined immediately upon reading, the color correction function can be used.

Because colors are simultaneously separated, line sequence reading is slower than page sequence reading.

Monochrome reading

The scanner scans the document with one pass, reading the image in monochrome (black-and-white). If the data format is set to 8 bits/pixel, 256 different gray tones can be registered during image scanning.

Dropout color (monochrome reading only)

The scanner does not read the dropout color (in other words, the scanner treats the dropout color as if it were white). For standard monochrome reading, the dropout color is green, which covers the major part of the visible spectrum. You can freely select green, red, or blue as the dropout color, however. Select a dropout color when there is a particular color you do not want to read (for example, when the desired image is against a colored background), or when green dropout in unsuitable.

The ESC C command sets the color mode. The default setting is monochrome.

1.11.7 Halftoning Mode

Generally speaking, 1 bit/pixel and 2 bit/pixel formats cannot express continuous image tones. The halftoning mode processes the scanned image data so that the data output in these formats simulates continuous tones when displayed or printed. The halftoning mode is suitable for use with continuous-tone images (such as photographs), and in conjunction with output devices that cannot handle multi-bus data for each pixel. Halftoning mode is not suitable for images requiring sharp definitions (line art, characters).

The user can select whether or not to use halftoning. When halftoning is disabled,the data format determines which tones can be reprinted. Halftoning mode is not useful and cannot be selected for data formats of 3 or more bits per pixel.

If you decide to use halftoning, you may choose from among the three halftoning modes outlined below.

Halftoning mode A

This is the standard halftoning procedure. The scanner converts the image into a hard-toned output which maintains strong image definition. This mode is suitable for most purposes. (Can be used with both 1 bit/pixel and 2 bit/pixel formats.)

Halftoning mode B

The scanner converts the image to a soft-toned output. This mode is suited for images in which similar tones cover fairly large areas. (Can be used with 1 bit/pixel format.)

Halftoning mode C

Image representation is similar to newspaper image printing (net screening). Tone gradations are represented by clusters having different numbers of dots. (Can be used with 1 bit/pixel format.)

The ESC B command selects the halftoning mode. DIP switches SW2-1 to SW2-3 can be used to select the default setting.

1.11.8 Gamma Correction

This function adjusts the image input/output light intensity ratio, so that tones can be preserved when the image is output to different types of devices. This ratio is called "gamma" (γ), and is represented by the slope of the lines shown in the graph below.

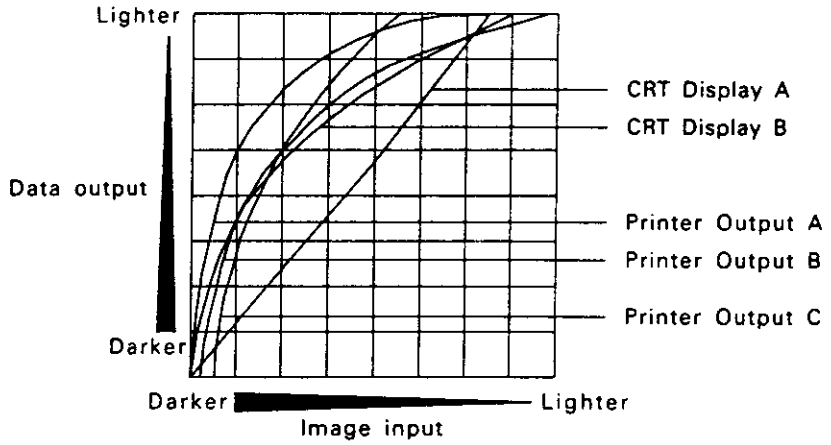


Figure 1-19. Gamma Correction

The scanner provides five different gamma correction settings. The gamma correction is set independently of other scanner functions.

CRT display A

The output data is directly proportional to the original image. This setting is generally suited to computer displays that show images in 1 bit/pixel/color format. The mode is also suited for images (such as line art) which lack continuous tones. For this mode, $\gamma = 1$.

CRT display B

This setting is suitable for analog-input CRTs. These CRTs display images using multiple tone levels (exceeding 1 bit/pixel/color). For this mode, $\gamma = 2.2$.

Printer output A

This setting is suitable for high density (e.g., 24-dot) printers. The image is lightened to compensate for the higher (darker) density generated by these printers. If this mode is used to output the image to a CRT, the image will appear faint.

Printer output B

This setting is suitable for low density printers—such as 8-dot (9-pin) printers—and for page printers. The image is slightly darkened to compensate for the lower (lighter) density of these printers. If this mode is used to output the image to a CRT, the image will appear faint.

Printer output C

This setting provides greater contrast and definition than printer outputs A and B. This setting is suitable for high contrast printing of images containing both pictures and text. The dark sections of the original are further darkened, and the light sections on the original are further lightened.

The ESC Z command sets the gamma correction. DIP switches 2-3 to 2-5 can be used to select the default setting.

1.11.9 Color Correction

The color correction function can operate only when the scanner is in color line sequence mode, under which pixel color is determined immediately upon scanning. Four color-correction settings are provided. To disable color correction, select either color page sequence reading or monochrome reading.

This color-correction function processes image data to achieve optimal conformance with the characteristics of the color output device being used. CRTs, for example,create colors by combining the additive primary colors (green, red, and blue). In contrast, printers use subtractive primary colors (magenta, cyan, and yellow). Printers may also add an additional block to increase the definition. For printers,colors may also vary according to the printing method or ink type.

CRT displays

This setting provides color compensation to match the characteristics of color CRT displays.

Impact dot matrix printers

This setting provides color compensation to match the characteristics of impact dot-matrix color printers.

Thermal transfer printers

This setting provides color compensation to match the characteristics of thermal-transfer color printers.

Ink jet printers

This setting provides color compensation to match the characteristics of ink-jet color printers.

The ESC M command selects the color correction mode. DIP switches 2-5 to 2-7 can be used to select the default setting.

1.12 MAIN COMPONENTS

To simplify maintenance and repair, the main components of the GT-6000 have been designed to allow for easy removal and replacement. The main components are as follows:

- Main board: main control circuit
- Power supply board: power supply circuit
- Filter board: Filter circuit
- Sub board: interface connecting circuit
- Sub-B board: DIP switch circuit
- Panel board: control panel circuit
- Transformer
- Carriage assembly (Scanner head)
- Lower case with scanner engine
- Upper case
- Manuscript cover

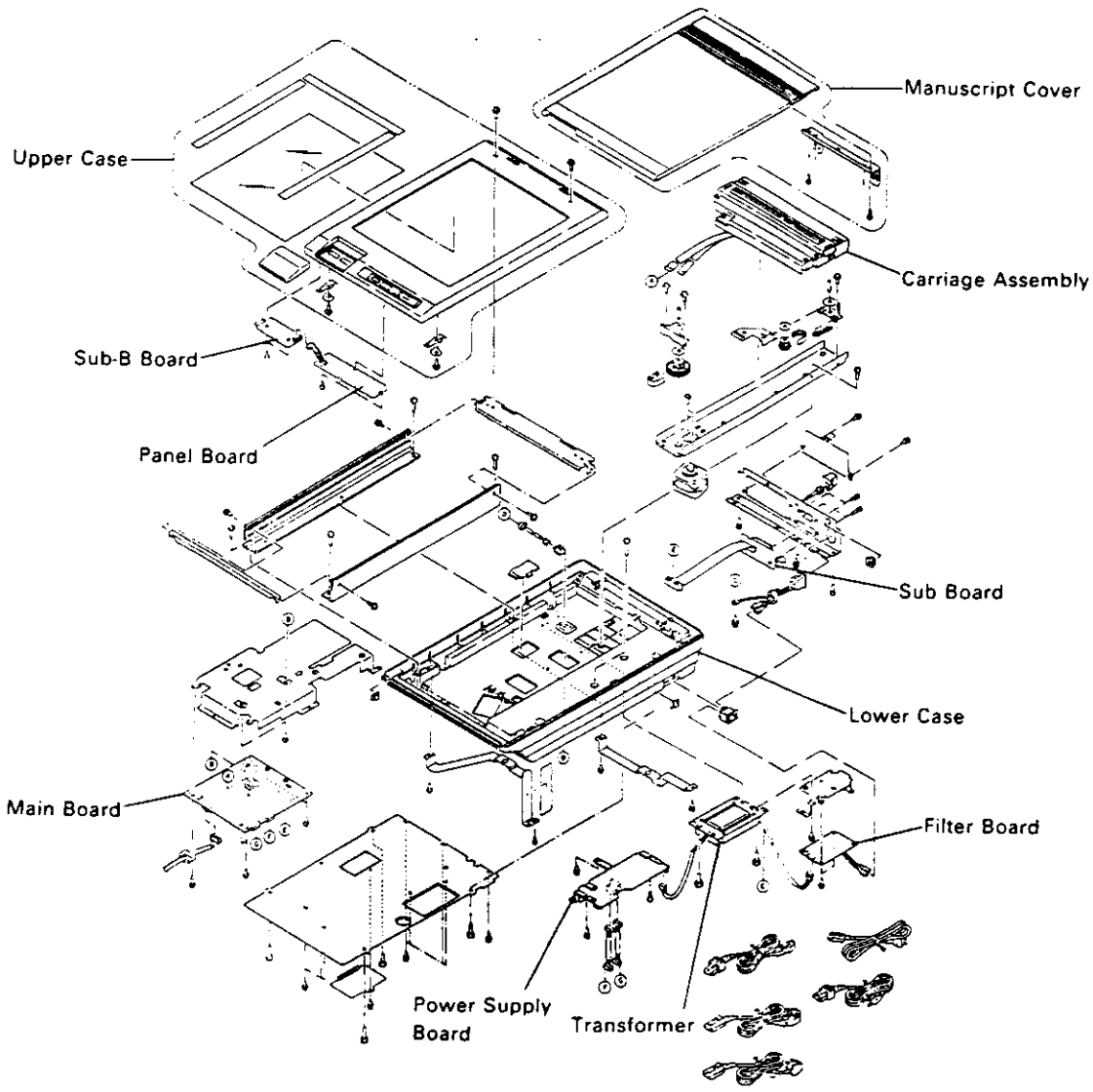


Figure 1-20. GT-6000 Component Layout

1.12.1 Main Board

The use of the HD64180 CPU simplifies the circuit design of the main control board. The CPU controls all main functions.

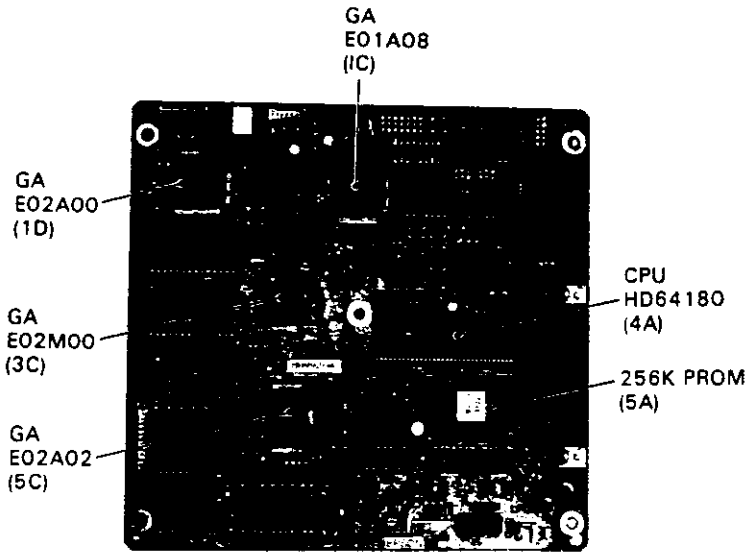


Figure 1-21. Main Board

1.12.2 Power Supply Board

The power supply board converts the input AC voltage to the DC voltages (+24V, +12V, −12V, +5V) required by the scanner. The board also incorporates the PB3717A, which drives the carriage motor.

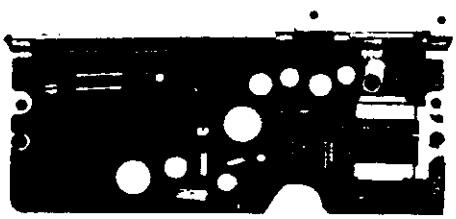


Figure 1-22. Power Supply Board

1.12.3 Filter Board

The filter board filters out the noise on the incoming AC line. The fuse on the board prevents overheating.

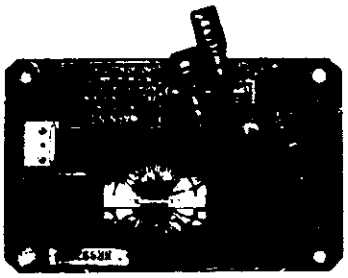


Figure 1-23. Filter Board

1.12.4 Sub Board

The sub board carries interface signals from the main board to the interface connectors. The board contains an RS-232C interface connector and a parallel interface connector.

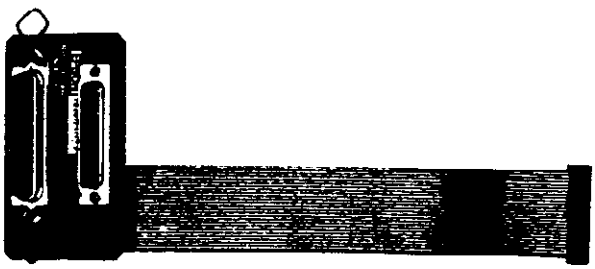


Figure 1-24. Sub Board

1.12.5 Sub-B Board

The sub-B board incorporates the two DIP switches panels. The panels are located on the upper case for easy access.

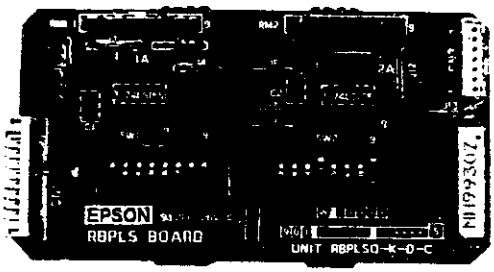


Figure 1-25. Sub-B Board

1.12.6 Panel Board

This is the GT-6000's control panel. It contains the operating switches and the indicator LEDs.

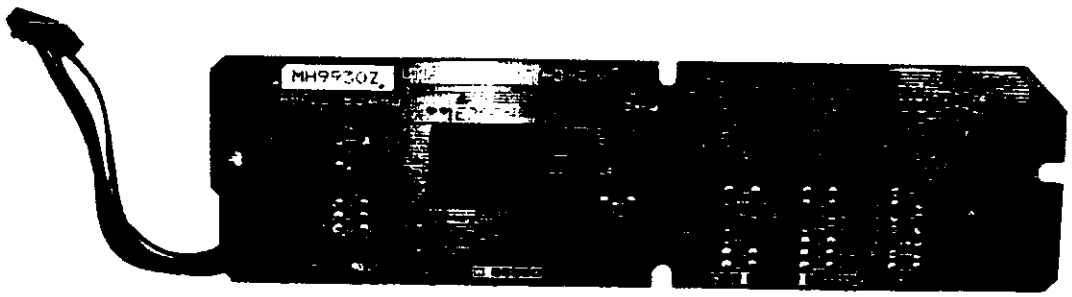


Figure 1-26. Panel Board

1.12.7 Transformer

The transformer changes the AC input from the filter circuit into 26 VAC and 12 VAC. These are then supplied to the power supply board.

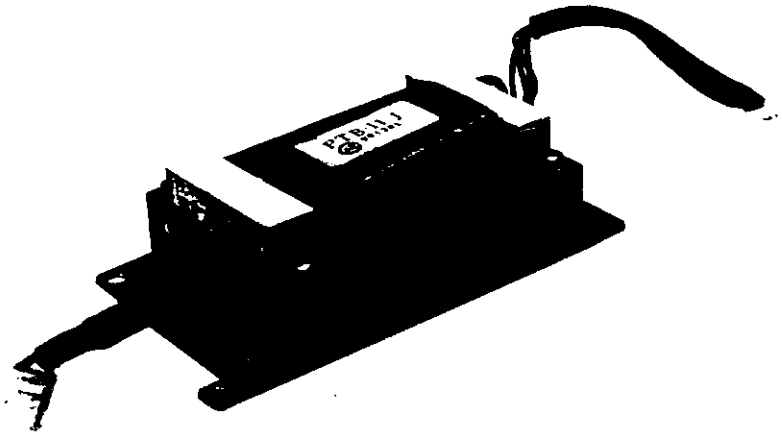


Figure 1-27. Transformer

1.12.8 Carriage Assembly (Scanner Head)

The carriage assembly (scanner head) is a 300 DPI CCD (Charge Coupled Device) line sensor. The carriage assembly also contains the R.G.B. noble-gas fluorescent lamps.

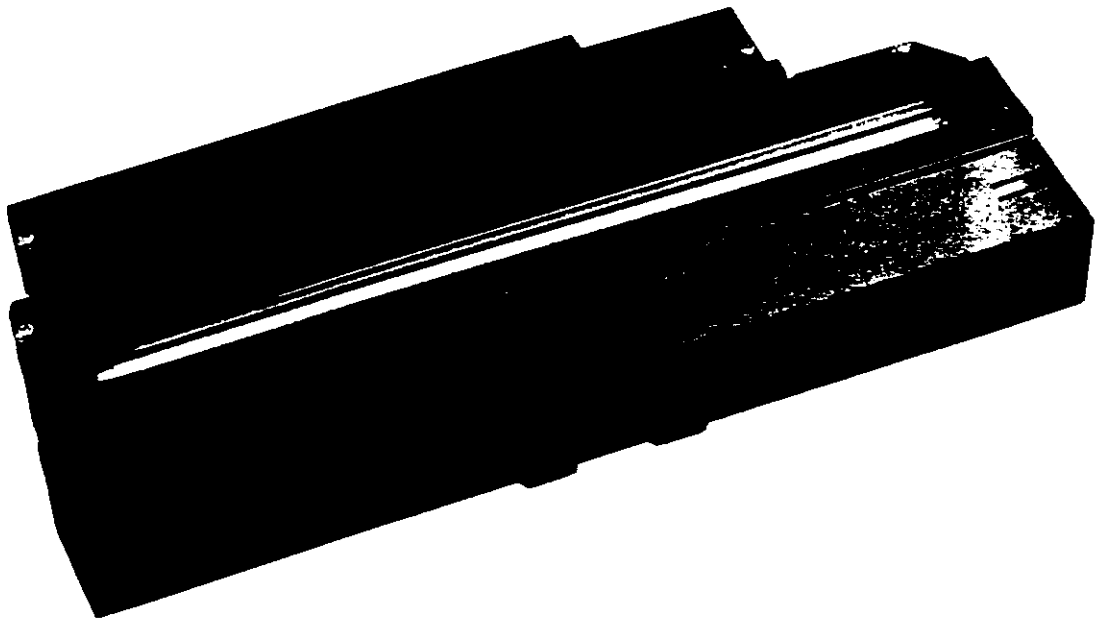


Figure 1-28. Carriage Assembly (Scanner Head)

1.12.9 Lower Case

The lower case incorporates the scanner engine components. These components include the carriage motor, the carriage mechanism, the home position sensor, and the scanner head.

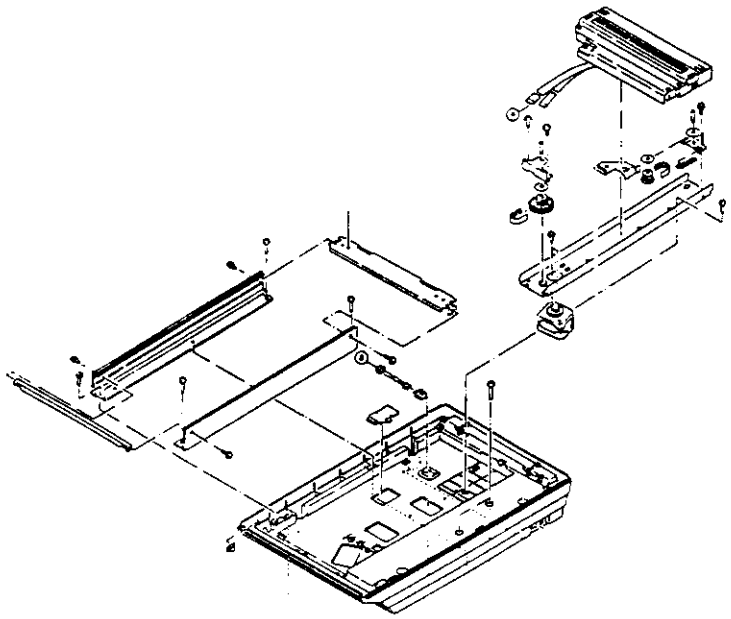


Figure 1-29. Lower Case, with Scanner Engine

1.12.10 Upper Case

The upper case includes a glass manuscript cover and a scale.

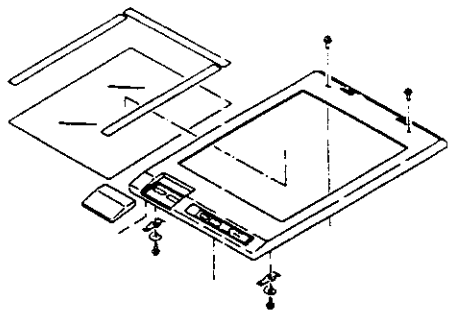


Figure 1-30. Upper Case

CHAPTER 2
OPERATION PRINCIPLES

LIST OF FIGURES

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2.1 OUTLINE OF ENGINE OPERATION

This section describes the functions and operating principles of the GT-6000 engine.

The engine contains a CCD image scanner with a reading resolution of 300 dpi. The engine consists of two main sections: 1) the scanner head, and 2) the carriage-movement mechanism.

2.1.1 Scanner-Head Operation

The scanner head is comprised of two main sections: the CCD image scanner, and the light source used to enable reading. Figure 2-1 shows a cross-section of the scanner head.

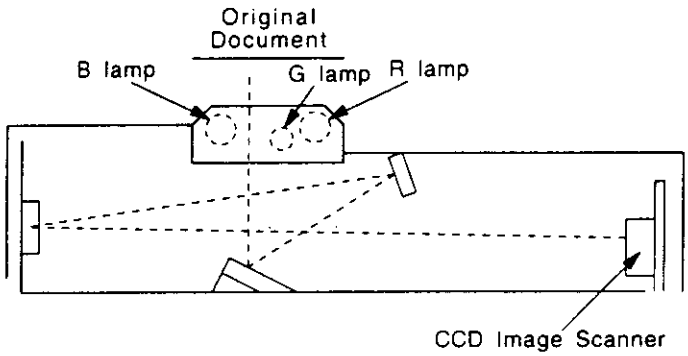


Figure 2-1. Cross-section of Scanner Head

Light-source operation is as follows. The light source is comprised of three noble-gas fluorescent lamps; one green, one red, and one blue. In order to read a color original, the three primary colors (red, green, blue) must be read individually. If the image is to be reproduced on a CRT, the individual readings are reconstituted on the display.

In order to read individual colors, the original document is illuminated separately by each color of light. The green lamp is used as the light source for reading the green component; the red lamp is used to read the red component; the blue lamp is used to read the blue component.

The operation of the CCD image sensor is as follows. The image sensor is divided into three blocks, as shown and described below.

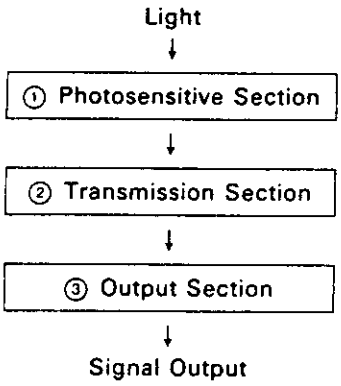


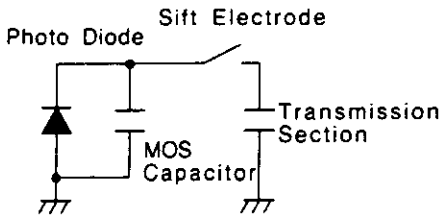
Figure 2-2 shows the relationship between these three blocks. Light reflected off the original document strikes the 1 photosensitive section, where photoelectric conversion takes place; signal charge proportional to the received light energy accumulates. The 2 transmission section transmits the accumulated signal to the 3 output section. The output section outputs the received signal charge in the form of an electrical signal.

Figure 2-2. Functions of Image Sensor Mechanism

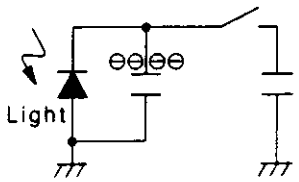
Each of the three CCD sections is explained in greater detail below.

1 Photosensitive section

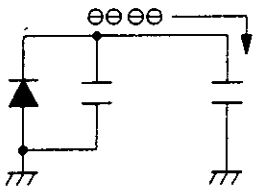
The photosensitive section converts light energy into electrical signals, and performs short-term accumulation of the resulting signal charge. The way in which the photoelectrical conversion process changes the incoming light energy into accumulated signal charge is explained below.



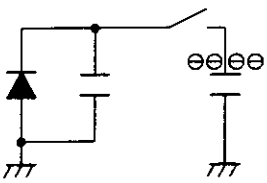
The operating principle of the photosensitive section is shown by the equivalent circuit drawn at left. The circuit consists of a photodiode, a MOS capacitor,and a shift electrode. (The transmission section, which follows the photosensitive section, is also simply illustrated in terms of capacitance.)



Light reflected from the original document impacts the photodiode, which converts the energy into a corresponding amount of photoelectric cirremt. The resulting photoelectric current causes the MOS capacitor to accumulate electrons whose number is in proportion to the strength of the originally received light.



When the shift electrode goes on,the electrons accumulated in the MOS capacitor are released.



The shift electrode then goes off,which completes the transfer of the signal-charge to the transmission section.

Figure 2-3. Operating Principle of Photosensitive Section

The above photosensor sections are arranged in parallel rows, where the number of units in each horizontal row is equivalent to the maximum number of pixels per line plus α (dummy).
Figure 2-4 illustrates the arrangement.

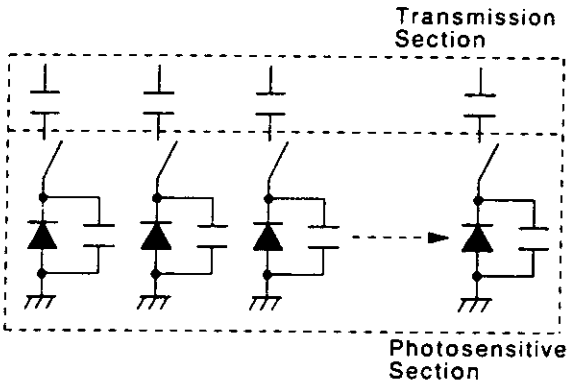
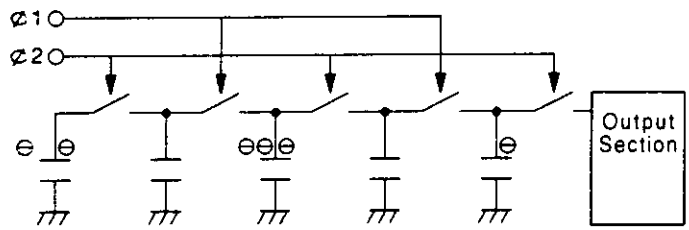


Figure 2-4. Arrangement of Photosensors

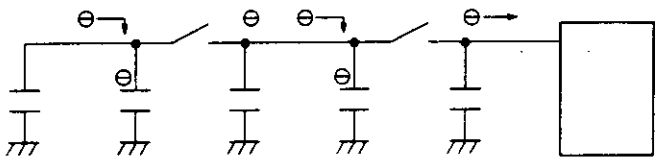
2 Transmission Section

This section receives the signal charge from the photosensitive section and transfers it to the output section. The transmission process is as follows. The transmission section contains two capacitors for each photodiode in the photosensitive section.

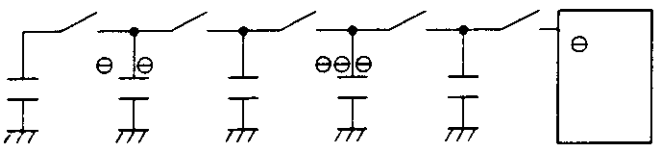
There is only one output section, which means that signal charge for each pixel must be sent separately to the output section. The operation is illustrated by the diagram and explanations below.



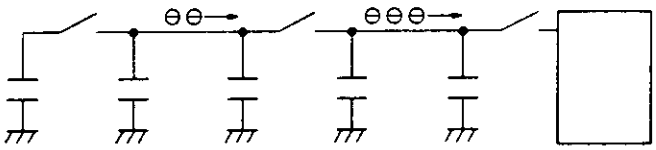
The diagram at left is a simple illustration of the transmission section. $\phi 1$ and $\phi 2$ are transmission pulses. The photoelectrically converted signal charges are stored in the capacitors.



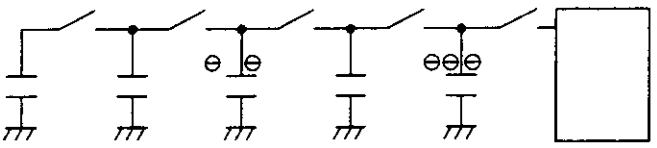
When transmission pulse $\phi 2$ goes ON, signal charges move to the capacitor at their right. This charge that exists on the rightmost capacitor is transmitted to the output section and then to the main board.



When transmission pulse $\phi 2$ goes OFF, the condition of the section becomes stable.



When transmission pulse $\phi 1$ goes ON, charges again move to the capacitor at their right.



When transmission pulse $\phi 1$ goes OFF, the condition of the section again becomes stable. By continual repetition of these operations, signal charges for all pixels are transmitted to the output section.

Figure 2-5. Operation of Transmission Section

3 Output Section

The output section receives signal charges from the transmission section and sends them out of the unit (i.e., to the main board). The section must receive a reset signal from the main board following outputting the signal for each pixel.

2.1.2 Carriage Operation

Because photosensor elements are aligned and have a one-to-one correspondence with a horizontal row of pixels, no mechanical operation is required for the main scan (one horizontal reading of the original document). To read more than a single line, however, vertical movement (sub-scanning) is also necessary. This requires mechanical movement of the scanner head. In other words, scanning is performed by reading one line at a time, moving in the vertical direction. The operation is illustrated in Figure 2-6.

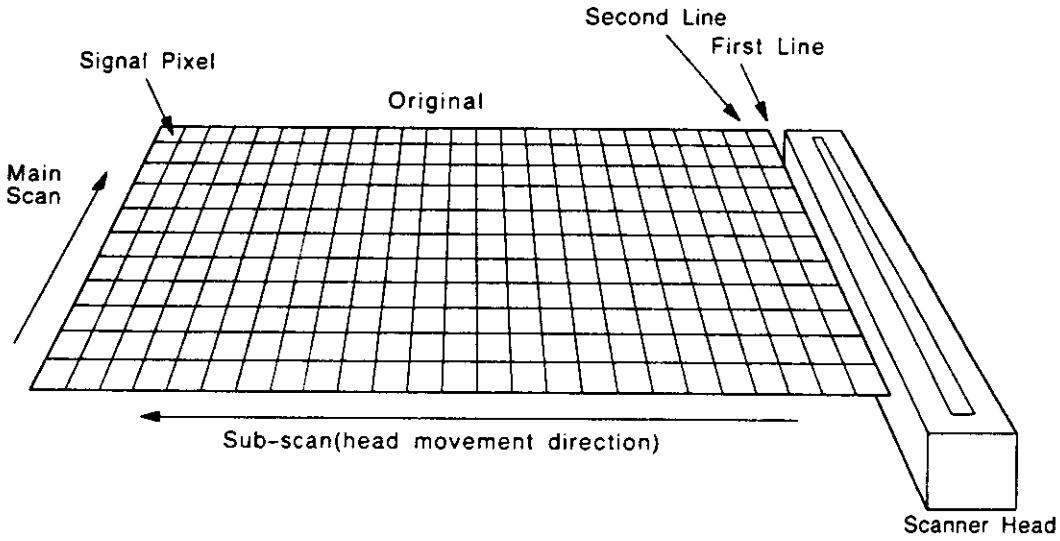


Figure 2-6. Reading of Original Document

A carriage mechanism is used to move the scanner head. A timing belt is inserted into the base of the carriage. The carriage motor (stepping motor) drives the timing belt by means of the carriage pulley; the carriage moves back and forth along the rail, carrying the scanner head with it.
A home-position sensor is used to detect when then the carriage is in home position.

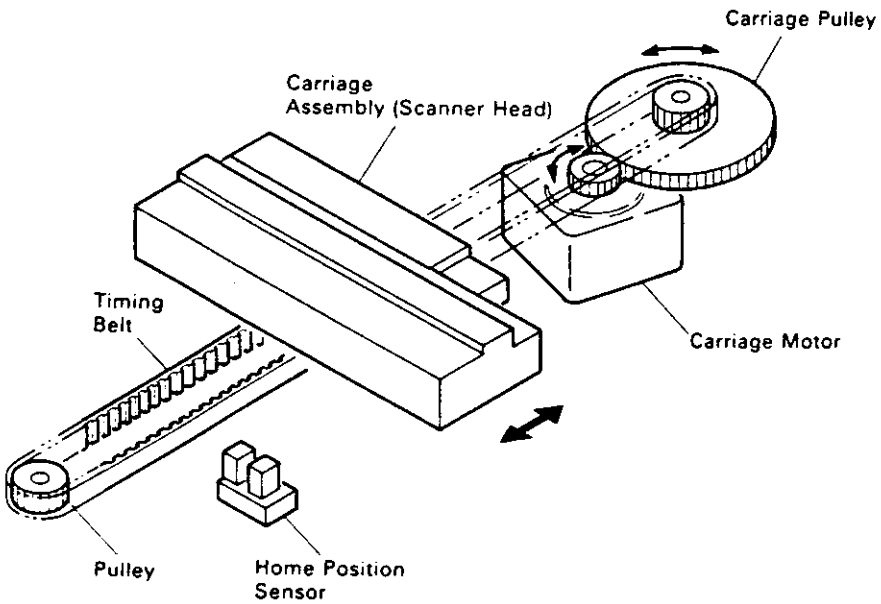


Figure 2-7. Carriage Operation

2.2 POWER CIRCUIT

The power supply section is composed of a filter board, a transformer, and a power board. This section outputs the DC current necessary to drive the scanner engine and control circuits. Table 2-1 shows the rated input and outputs.

Table 2-1. Ratings of Power Supply Section

Input	Output
220VAC+/−10%	+5VDC, 1A +24VDC, 0.9A +12VDC, 0.1A +12VDC, 0.1A

2.2.1 Power Circuit Outline

Table 2-2 shows the DC voltages created by the power section, and the uses to which each voltage is applied.

Table 2-2. Voltages and Applications

Supply Voltage (DC)	Application
+24VDC - Gp	Carriage motor Fluorescent lamps
+5VDC - GND	Control-board logic circuits Home-position sensor Control panel Option board Carriage motor driver IC
+12VDC - AG	Scanner head A/D converter standard voltage, drive Image-signal amplifier RS-232C interface
−12VDC - AG	Scanner head Image-signal amplification RS-232C interface

2.2.2 Operation

Figure 2-7 is a block diagram of the power supply circuitry.

External AC power is input into the unit, and the high frequency component of the power is removed by the action of the input filter. The result is then input into the reducing transformer, which converts it into 26V and 12V AC voltages. These voltages are input into the power-supply board.

The 26V AC power is converted into +36V DC by full-wave rectification. The +36V DC is fed into two switching circuits. The action of these switching circuits and the following smoothing circuits produces stabilized +24V DC and +5V DC outputs. These outputs are fed to the control circuitry.

The 12V AC produced by the reducing transformer is passed into two half-wave rectifiers; one of these outputs +12V DC, the other outputs −12V DC. Each of these voltages is then stabilized by passage through a regulator circuit and then a smoothing circuit. The stable +12V DC and −12V DC voltages are then supplied to the control circuitry.

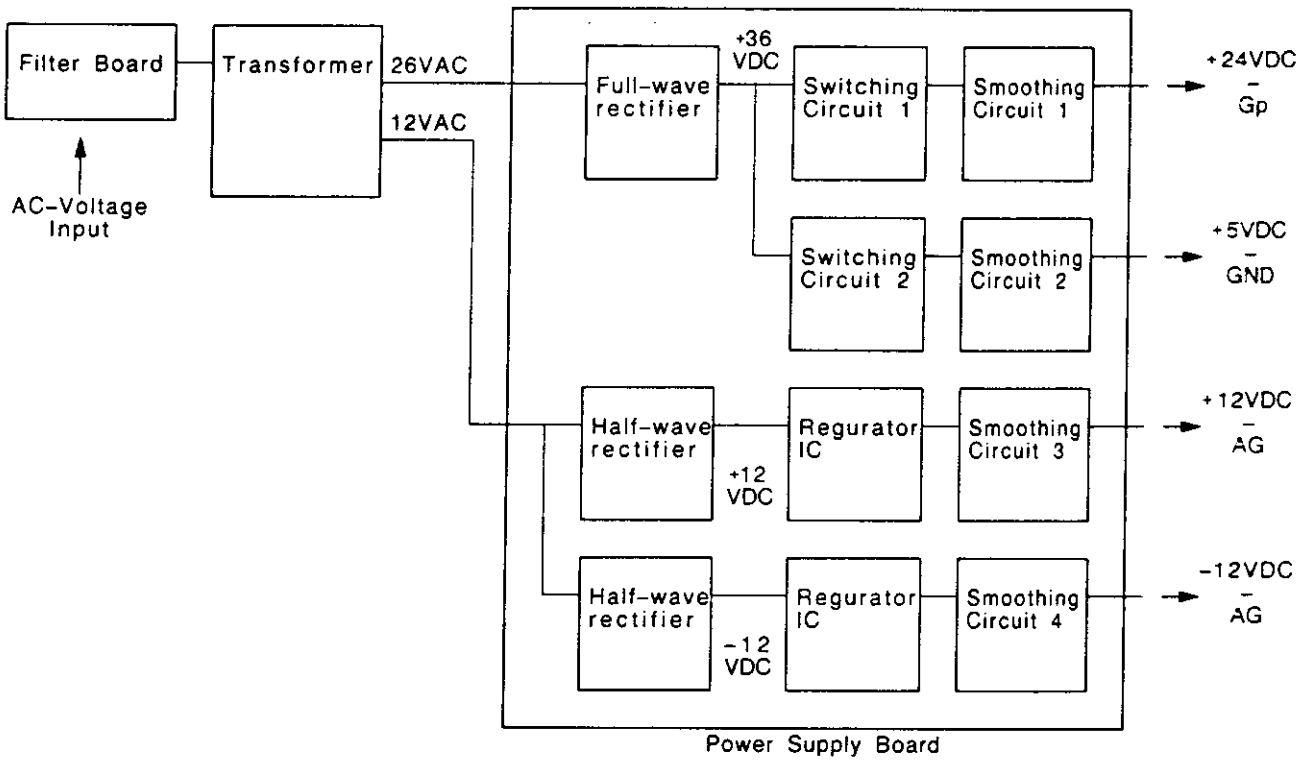


Figure 2-8. Block Diagram of Power Supply Circuits

2.3 Control Circuits

The scanner's control circuits are implemented using a total of five boards.

2.3.1 Control Circuit Outline

For its CPU, the scanner uses the 8-bit, single chip HD64180. The CPU is operated at 12MHz. To simplify the circuitry, the circuits for correcting the image-data signals are collected into three gate arrays.

Figure 2-9 is a block diagram of the control circuitry.

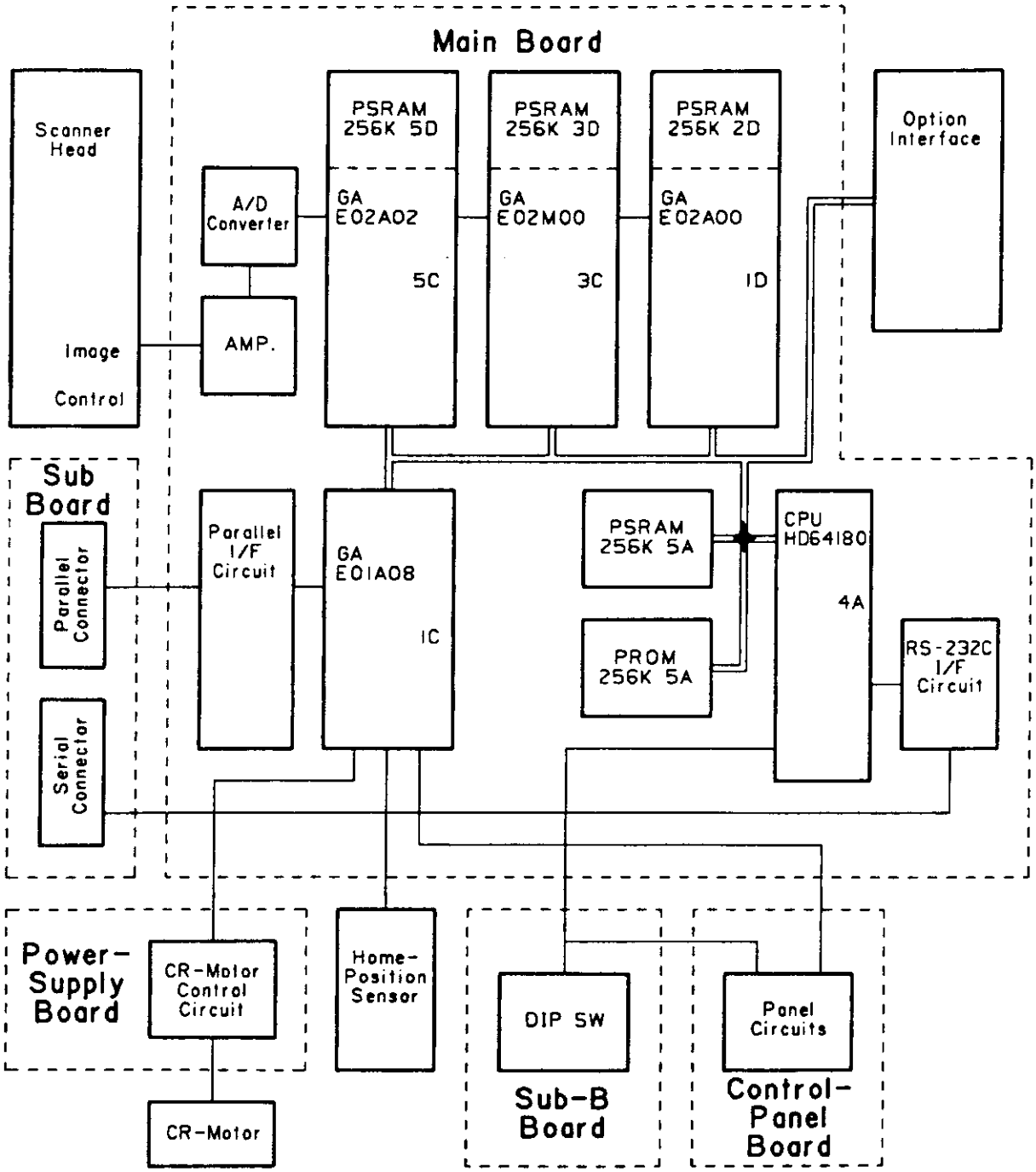


Figure 2-9. Block Diagram of Control Circuits

Table 2-3 describes the functions of the main ICs.

Figure 2-10 shows the general flow of operation, starting from the point where image-data is input into the GT-6000, and ending with the output of image-data to a computer or printer.

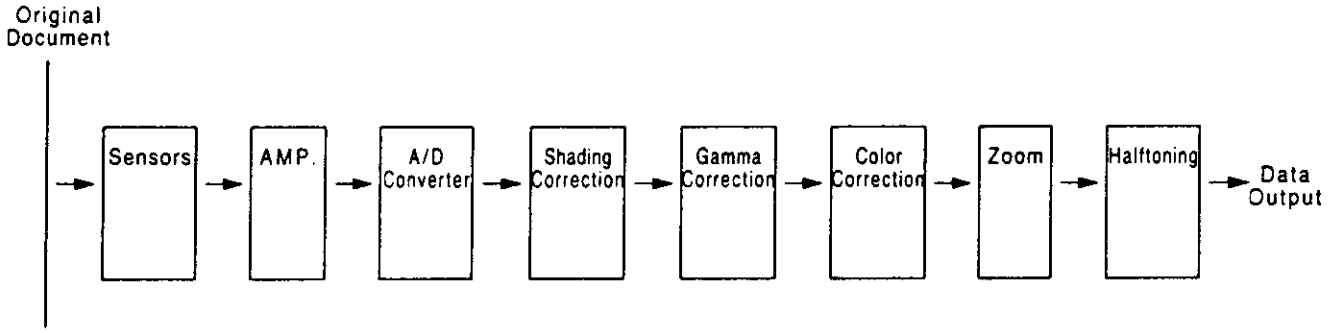


Figure 2-10. Outline of GT-6000 Operation

(1) Lamps light, and scanner read white standard attached to back surface of document glass.
(2) Lamps go out (so that there is not reflection), and scanner reads black standard.
(3) Lamps light. Light reflected from the document is read by sensors.
(4) The read-in data are amplified.
(5) The amplified analog image data is converted to 8-bit digital data by the 8-bit A/D converter.
(6) Shading correction is applied to the 8-bit digital data. The white and black standards [read in steps (1) and (2), above] determine the shading correction.

Note about Shading Correction

The image data sent out by the sensors is derived by direct photoelectric conversion of the reflected light that impacts the sensors. This data must be further converted before it can be output from the device (e.g., before it can be used for reproducing the image on a CRT). The use of white and black standards in performing this type of conversion is referred to as "shading correction." The correction value is determined from the expression:

(image data – black standard)/(white standard – black standard)

In other words, image data is calculated in terms of its proportional relation to white data.

(7) Gamma correction is performed based on DIP switch settings or commands sent from computer. (Gamma correction is explained in section 1.11.8.)
(8) Color correction is performed based on DIP switch settings or commands sent from computer. (Color correction is explained in section 1.11.6.)
(9) Zoom correction is performed based on DIP switch settings or commands sent from computer. (Zoom correction is explained in section 1.11.2.)
(10) Halftoning is performed based on DIP switch settings or commands sent from computer. (Halftoning is explained in section 1.11.2.
(11) Image data is output to computer or other external device.

Table 2-3 lists the functions of the scanner's main elements.

Table 2-3. Functions of Main Elements

Element	Location	Function
CPU	4A	The CPU, which operates at 12MHz, controls scanner operation. The CPU also possesses a 2-channel serial interface. Channel 0 is the RS-232C interface; channel 1 is used to handle DIP switches and drive the control panel LEDs.
8-bit A/D Converter	9C	The converter converts the analog image-data read by the sensors into 8-bit digital data.
Gate Array	5C	This gate array performs the following. • Fluorescent lamp control • Sensor control • Control of A/D converter • Shading correction • Gamma correction • Color correction This gate array is connected to 256K of external RAM.
Gate Array	3C	This gate array performs the following. • Zoom This gate array is connected to 256K of external RAM.
Gate Array	1D	This gate array performs the following. • Halftoning This gate array is connected to 256K of external RAM.
Gate Array	1C	This gate array performs the following functions. • Bi-directional parallel interface • Control of CR motor • Reading of home-position sensor • Reading control-panel switch status This gate array is connected to 256K of external RAM.

2.3.2 Reset Circuit

Figure 2-11 shows the reset circuit, which is used to reset the controls. Immediately after power ON and power OFF, the voltage of the +5V DC line drops and the reset IC outputs the reset signal. In addition, $\overline{\text{INIT}}$ signals sent though the parallel interface by an external device are ANDed with the $\overline{\text{RESET}}$ signal output by the reset IC. If an externally generated $\overline{\text{INIT}}$ signal is input, the AND circuit outputs the $\overline{\text{RESET}}$ signal, resetting the scanner.

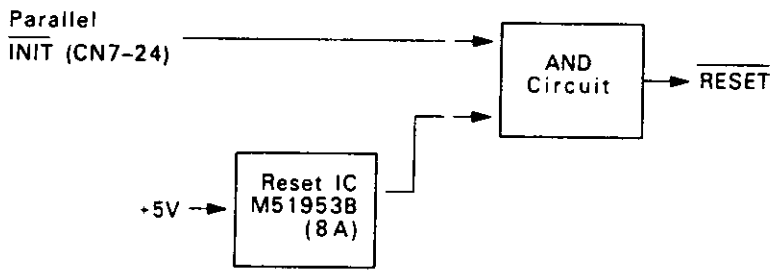


Figure 2-11. Block Diagram of Reset Circuit

2.3.3 Home-Position Sensor Circuit

The home position sensor detects whether the carriage is in home position. This sensor establishes the standard carriage-drive location. Figure 2-11 is a block diagram of the sensor circuitry. When the carriage is in home position, the sensor outputs a HIGH signal to gate array E01A08. The gate array's home-position detection element is allocated to CPU I/O space.

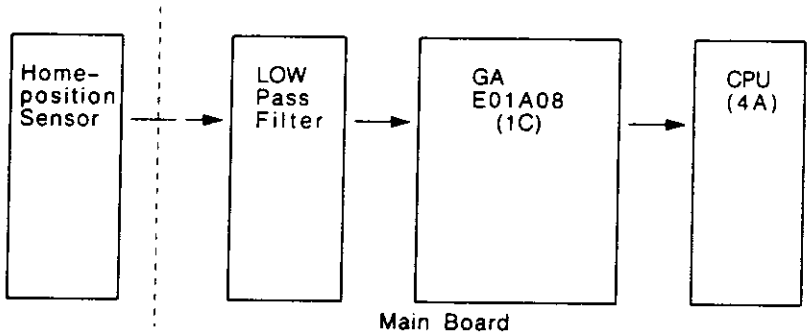


Figure 2-12. Block Diagram of Home Position Sensor Circuit

2.3.4 Carriage Motor Drive Circuit

Constant current is used to drive the carriage motor. Because a stepping motor is used for the carriage motor, a change in the excitation status is required to generate rotation. Table 2-4 indicates the relationship of the input and output excitation phase data of the PBL3717 motor driver. Table 2-6 indicates the excitation sequence required to rotate the motor, and Figure 2-14 shows the motor's internal wiring. Note that the motor can be rotated in reverse by reversing the excitation sequence given in Table 2-6.

There are four different drive speeds (including "stopped"). The drive speed is determined by the drive current, which is determined by the combination of P1A(B) and P0A(B). The different combinations are described in Table 2-5. The motor can be stopped by setting CONT to HIGH; this disables the operation of the PBL3717A motor driver (on the power supply board), so that the motor will not move.

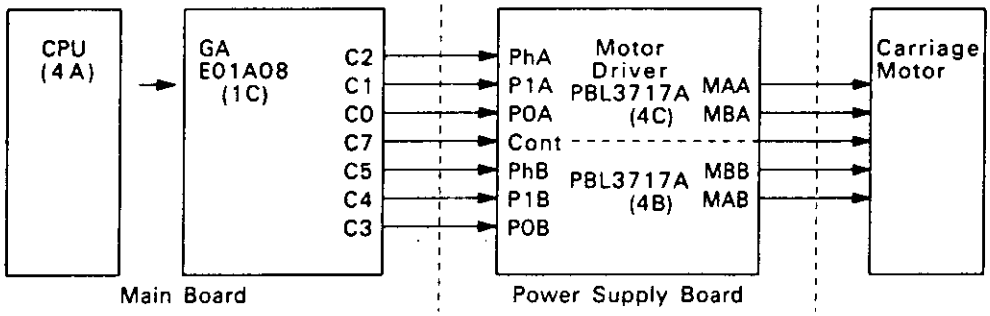


Figure 2-13. Block Diagram of Carriage Motor Driver Circuit

Table 2-4. Input and Output of The PBL3717A Motor Driver

Input	Output	
H	MAA(MBB)	+
	MBA(MAB)	−
L	MAA(MBB)	−
	MBA(MAB)	+

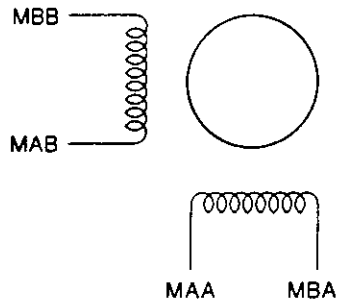


Figure 2-14. Internal Wiring of Motor

Table 2-5. Drive-Current Settings

I1A(B)	I0A(B)	Output Current
H	H	Stop
L	H	Low current
H	L	Medium current
L	L	High current

Table 2-6. Excitation Sequence

Step	MBB	MAA	MAB	MBA
1	−	−	+	+
2	+	−	−	+
3	+	+	−	−
4	−	+	+	−

2.3.5 Image-Sensor Drive Circuit

Figure 2-15 is a block diagram of the image-sensor drive circuit. Gate array E02A02 controls image sensor operation. The sensor receives the following control signals: the SP signal, which drives the main sensor's shift electrode; transmission pulses CK1 and CK2, which transmit the signal charges (and which are described, as o1 and o2, in Section 2.1.1); and the RS reset signal, which resets the image sensor's output section following the reading of each pixel. The image sensor receives these control signals, and outputs the image data as signal Vin. The process is illustrated in Figure 2-16.

The image data output by the image sensor is in the form of an analog signal. This signal is passed through an amplifying circuit. The amplifying circuit is provided with variable resistors VR1 and VR2. VR2 sets the amplification factor and determines the maximum output value. The maximum value occurs when the image sensor receives maximum reflected light from the scanned document; e.g., when the document's image area is pure white. In other words, the VR2 setting determines the value of the amplified output for a white image. VR1, in contrast, determines the value of the minimum amplified output. This is the value that applies when the scanned document reflects no light—i.e., when the image area is black. The method for setting VR1 and VR2 is described in Chapter 4.

The analog signal output from the amplifier is passed into an 8-bit A/D converter and converted into 8-bit digital data. This data is sent to gate array E02A02. Details of subsequent image processing may be found in Section 2.3.1.

The original document must be illuminated in order to be read. The scanner uses fluorescent lamps for this purpose. These lamps are also controlled by gate array E02A02. The gate array provides switching in order to maintain the proper radiation intensity.

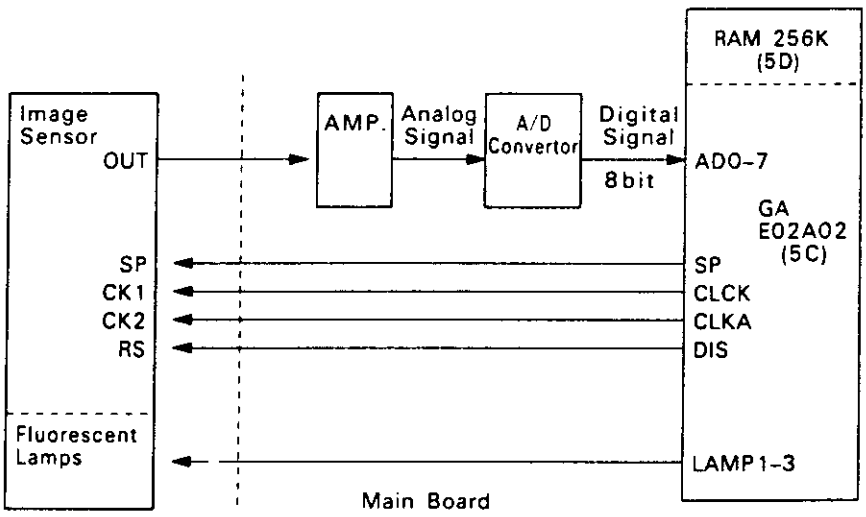


Figure 2-15. Image Sensor Drive Circuit

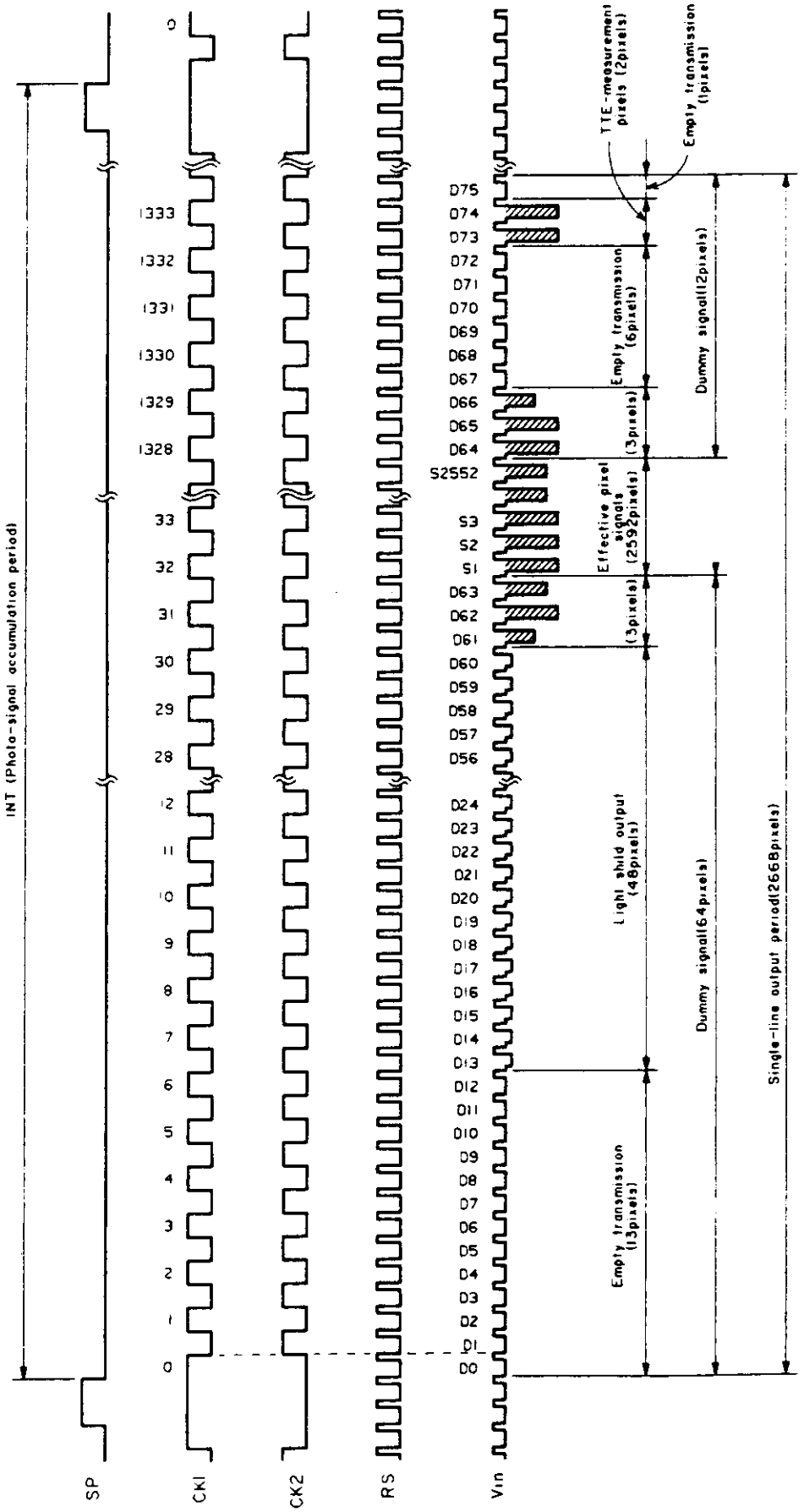


Figure 2-16. Image Sensor Control Process

LIST OF TABLES

CHAPTER 3
DISASSEMBLY AND ASSEMBLY

LIST OF FIGURES

3.1 OVERVIEW

This chapter explains important points relating to disassembly, assembly, and transporting of main components.

3.1.1 Precautions

Carefully read the following before beginning disassembly or assembly work.

- Before beginning work, be sure that the power and interface cables have been disconnected from the device.
- If you are disassembling the machine or performing an operation check, first remove the screw at the rear of the unit.

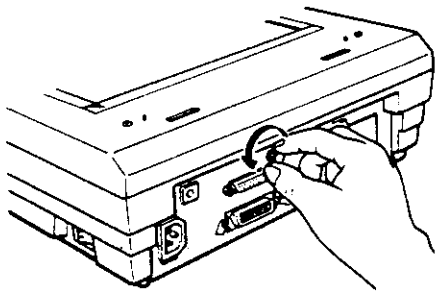


Figure 3-1. Removal of the Screw

- To maintain the unit in optimal condition, clean and apply adhesives as necessary following disassembly, assembly, and adjustment operations.
- If you are returning the unit to a customer, pack the unit according to the following procedure.

[Step 1] Replace and tighten the screw.

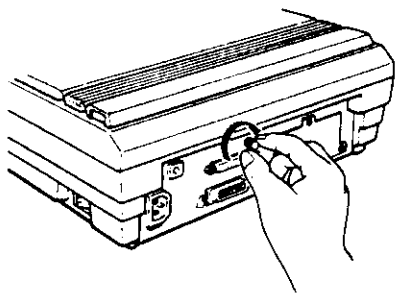


Figure 3-2. Installing Screw

[Step 2] Place rubber stopper over screws.

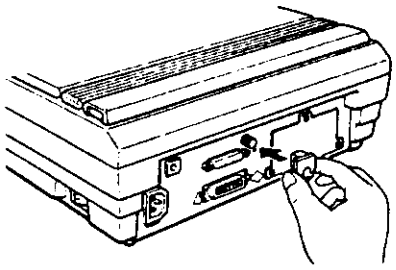


Figure 3-3. Applying Rubber Stopper

[Step 3] Remove the document cover and place in product box.

3.1.2 Tools

Use the tools listed in Table 3.1 for disassembly and assembly work.

Table 3-1. Tools

Name	Commercial Availability	Tool Code	Part Number
Philip's-head screwdriver No. 2	o		B743800200
Tweezers	o		B641000100
Cutting Pliers	o		
Regular screwdriver	o		

o: Commercially available
E: Company.specific

3.1.3 Service Shipping Standards

Table 3-2. Service Shipping Standards

Main Category	Sub-category	Content	Check
Operation	Sensor head	Do all 3 fluorescent lights switch ON normally?	☐ Check ☐ Unnecessary
	Carriage mechanism	Is movement smooth?	☐ Check ☐ Unnecessary
	Self-test	Normal? (☐ Page sequence, ☐ Line sequence)	☐ Check ☐ Unnecessary
	Image feeding	Is image feed performed normally by utility software?	☐ Check ☐ Unnecessary
Adjustment	Brightness-level adjustment	Normal adjustment value?	☐ Check ☐ Unnecessary
Function enhancement	ROM version	ROM version__?	☐ Check ☐ Unnecessary
Cleaning		Is the document cover clean?	☐ Check ☐ Unnecessary
		Is the inside of the unit free of dust?	☐ Check ☐ Unnecessary
		Is the outside of the unit clean?	☐ Check ☐ Unnecessary
Return shipping condition		Are screws inserted?	☐ Check ☐ Unnecessary
		Was document cover removed?	☐ Check ☐ Unnecessary
Separate items		Power cord	☐ Check ☐ Unnecessary

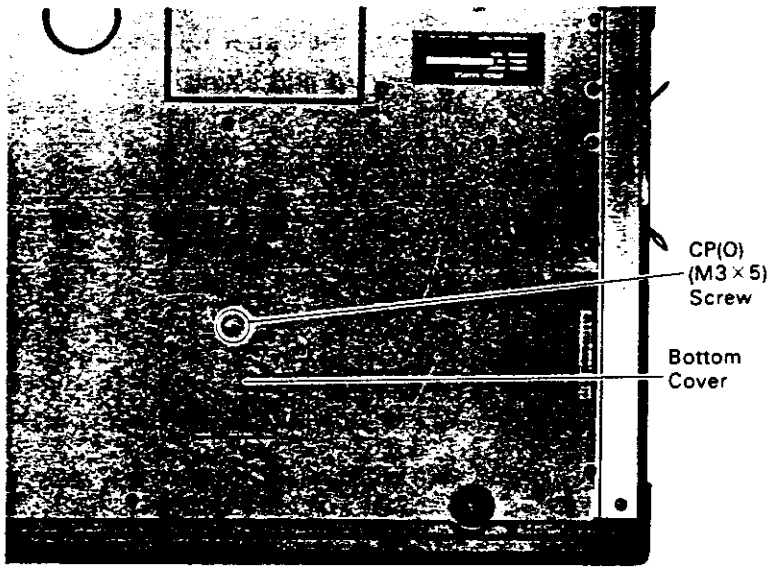
3.2 DISASSEMBLY AND REASSEMBLY PROCEDURES

This section provides a diagrammatic description of the procedure for removing the main components. Because the reassembly procedure is generally the direct reverse of the disassembly procedure, it is not described in detail: all points of difference, however, are noted. The section is divided into the following parts: (1) exchanging the ROM; (2) removing the housing; (3) removing the power-circuit board (including the transformer); (4) disassembling the scanner engine; and (5) disassembling the rear frame (removing the sub.board).

3.2.1 Exchanging the ROM

ROM exchange is an extremely simple procedure. Only the bottom cover must be removed.

[Step 1] Remove the CP(O) (M3 · 5) screw fixing the bottom cover to the bottom housing.
[Step 2] Remove the bottom cover.
[Step 3] Exchange the ROM.



Bottom View

Figure 3-4. Removal of Bottom Cover

3.2.2 Removing the Housing

This subsection explains how to remove the upper and lower housings. You must remove these housings if you plan to remove the power.circuit board or disassemble the scanner mechanism.

3.2.2.1 Removing the Upper Housing

[Step 1] Remove the document cover.

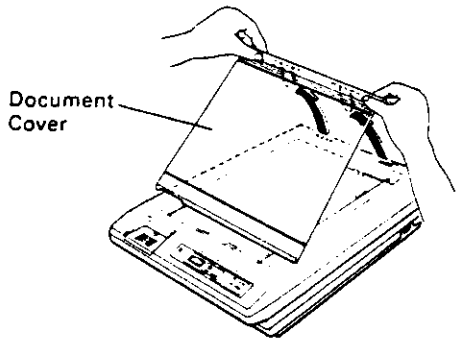


Figure 3-5. Removal of Document Cover

[Step 2] Remove the two CC (M3×6) screws fixing the upper housing.
[Step 3] Open the upper housing by pushing forward and lifting.

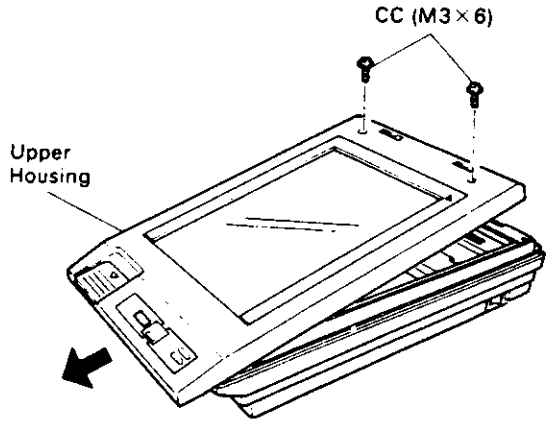


Figure 3-6. Removal of Upper Housing (1)

[Step 4] Detach connector CN1 from the Sub-B board to free the upper housing, and remove the housing.

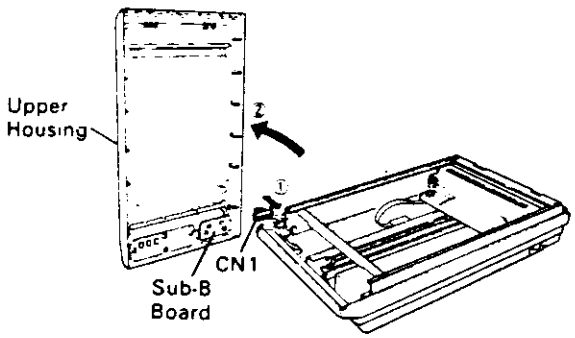


Figure 3-7. Removal of Upper Housing (2)

3.2.2.2 Removing the Bottom Housing

[Step 1] Turn the scanner upside.down.

[Step 2] Remove the CBB (M4 × 10) screw holding the four gummed supports in place, and remove the supports.

[Step 3] Remove the nine CP(O) (M3 × 5) screws holding the bottom housing in place.

[Step 4] Remove the bottom housing

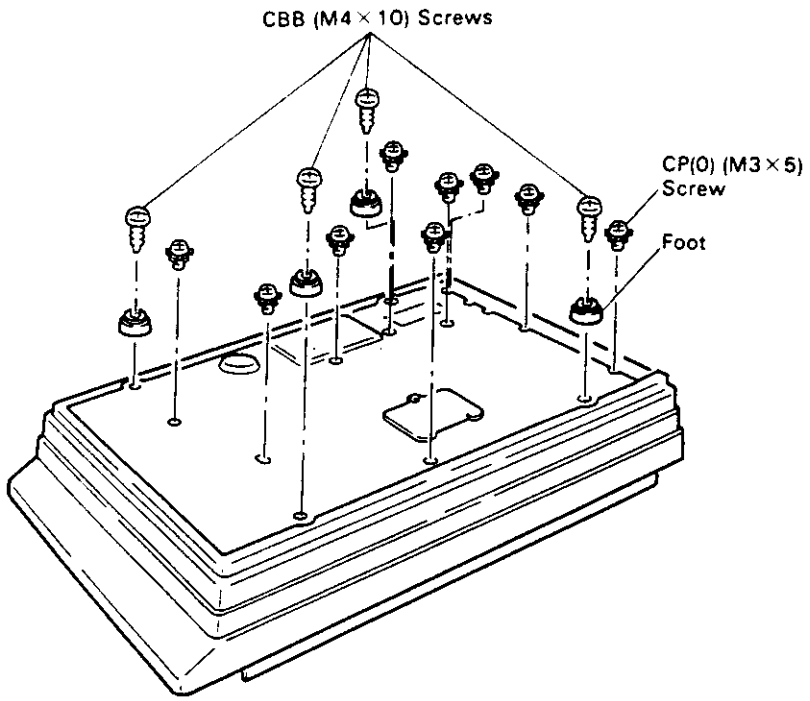


Figure 3-8. Removal of Bottom Housing

3.2.3 Removing the Power Circuit Board (and Transformer)

This section explains the procedure for removing the power circuit board (including transformer).

3.2.3.1 Removing the Main Board

[Step 1] Remove the attachment screws. [Refer to 3.1.1]
[Step 2] Remove the upper housing. [Refer to 3.2.2.1]
[Step 3] Remove the FFC cover that holds the scanner head FFC in place.

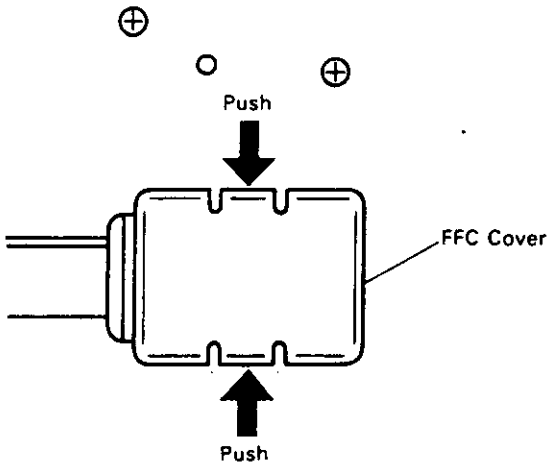


Figure 3-9. Removing the FFC Cover

[Step 4] Pull the FFC from connectors CN1 and CN2 on the main board.
[Step 5] Turn the scanner upside.down.
[Step 6] Remove the bottom housing.
[Step 7] Detach main board connectors CN3, CN7, CN8, and CN4.
[Step 8] The cable connecting the main and sub-B boards is fastened to the main board with a CC (M3×12) screw. Remove this screw.
[Step 9] Detach main board connector CN5.
[Step 10] Remove the four CC (M3×4) screws that are holding the main board in place. Then remove the main board.

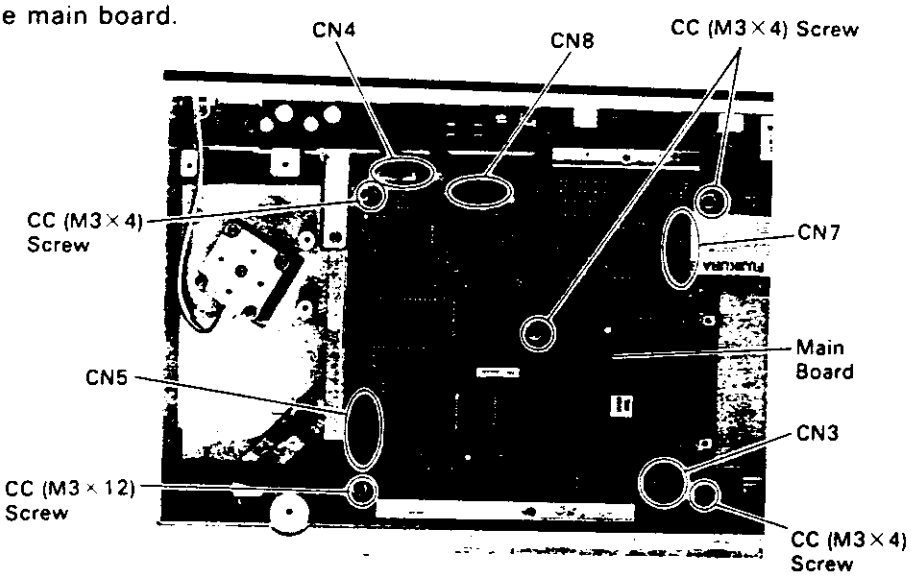


Figure 3-10. Removal of Main Board

REQUIRED ADJUSTMENT

If you are exchanging the main board, be certain to adjust the brightness level. (Refer to Section 4.2.)

3.2.3.2 Removing the Power Board

[Step 1] Remove the bottom housing. [Refer to 3.2.2.2]

[Step 2] Detach connectors CN1, CN2, CN3, and CN4 from the power board.

[Step 3] Remove the two CC (M3 × 8) screws and the CP(O) (M3 × 5) screw that are holding the power supply board in place. Then remove the power supply board.

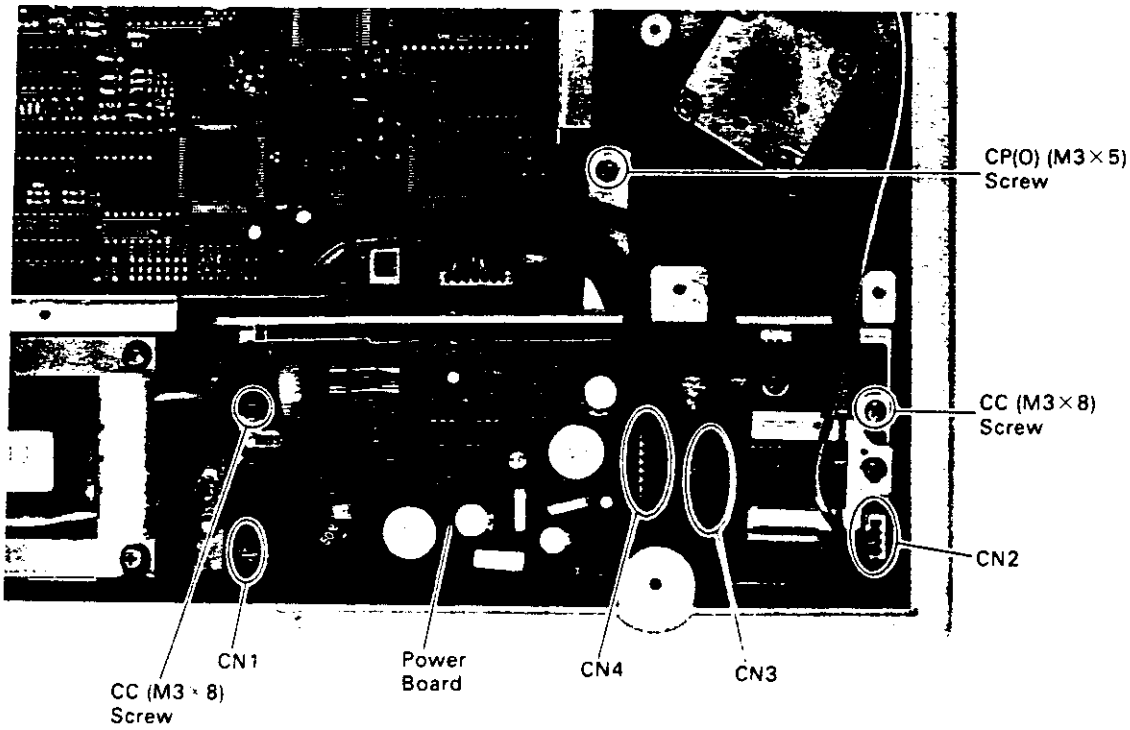


Figure 3-11. Removal of Power Supply Board

3.2.3.3 Removing the Transformer

[Step 1] Remove the upper housing. [Refer to 3.2.2.1]

[Step 2] Remove the two CP (M4x16) screws fastening the transformer to the lower housing.

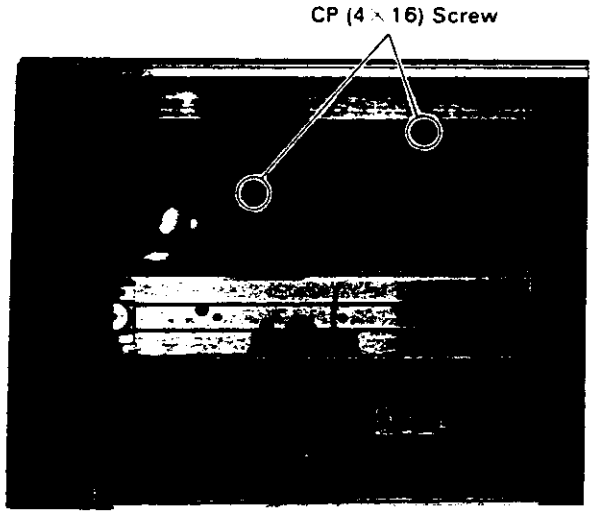


Figure 3-12. Removal of Transformer (1)

[Step 3] Remove attachment screw. [Refer to 3.1]

[Step 4] Turn the scanner upside.down.

[Step 5] Remove the bottom housing. [Refer to 3.2.2.2]

[Step 6] Detach connector CN1 from the power supply board.

[Step 7] Detach connector CN2 from the filter board.

[Step 8] The transformer is now held in place by remaining two CB (M4 × 10) screws. Remove these screws. Then remove the transformer.

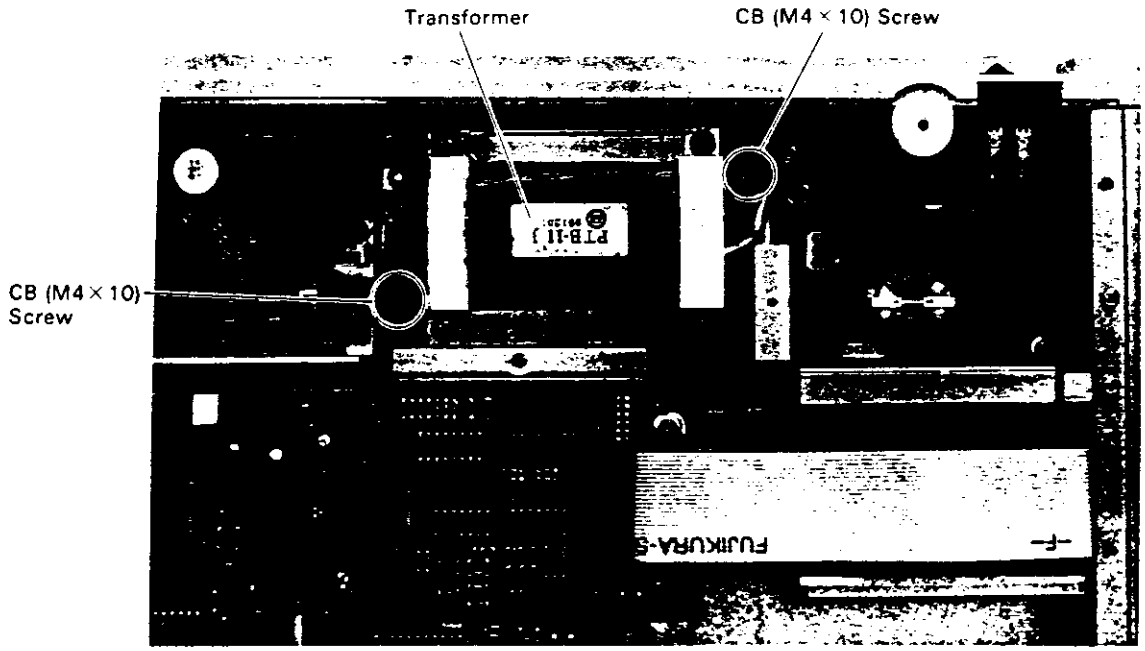


Figure 3-13. Removal of Transformer (2)

3.2.3.4 Removing the Filter Board

[Step 1] Remove the bottom housing. [Refer to 3.2.2.2]

[Step 2] Remove from the power connectors the two cords connecting the power switch to the filter board.

[Step 3] Detach connector CN2 from the filter board.

[Step 4] Remove the two CC (M3 × 4) screws and the CB(O) (M4 × 6) fastening the filter board in place. Remove the filter board.

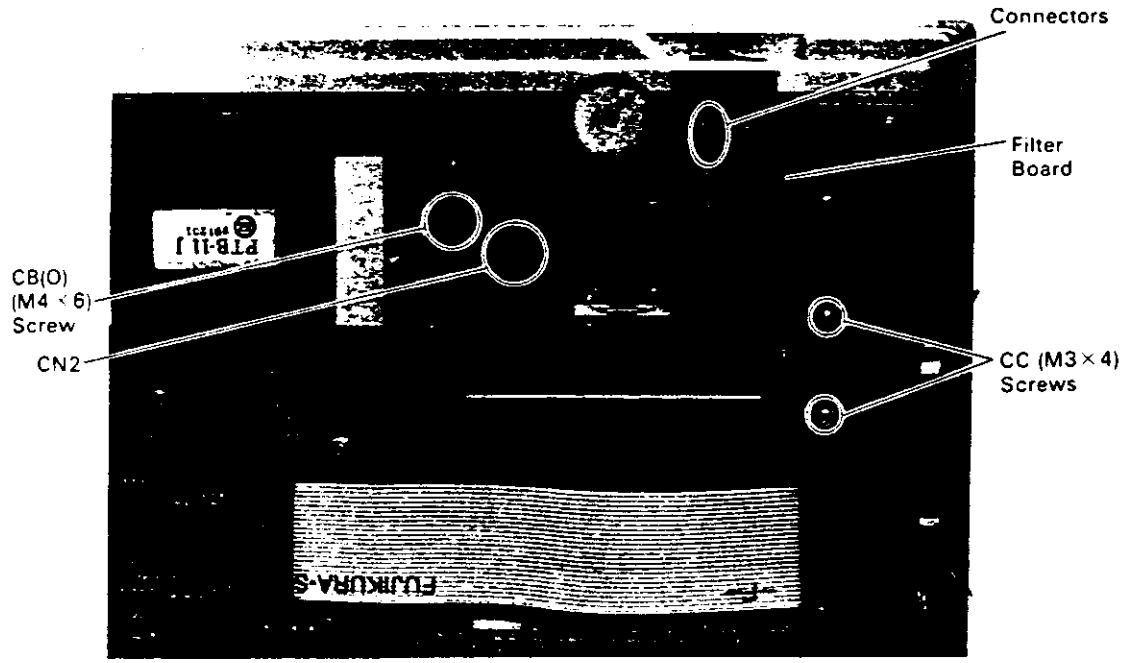


Figure 3-14. Removal of Filter Board

REASSEMBLY POINT

When reconnecting the cords to the power switch, the orientation of the power switch and the color of the cords should be as follows:

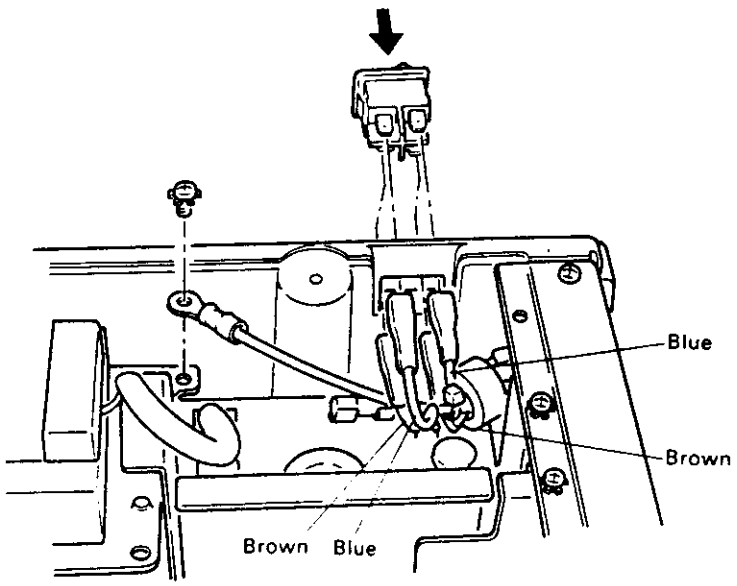


Figure 3-15. Connection of Power Switch and Cord

3.2.3.5 Removing the Sub-B Board

[Step 1] Remove the upper housing. [Refer to 3.2.2.1]

[Step 2] Remove the two CBB (M3×5) screws fastening the sub-B board to the lower housing.

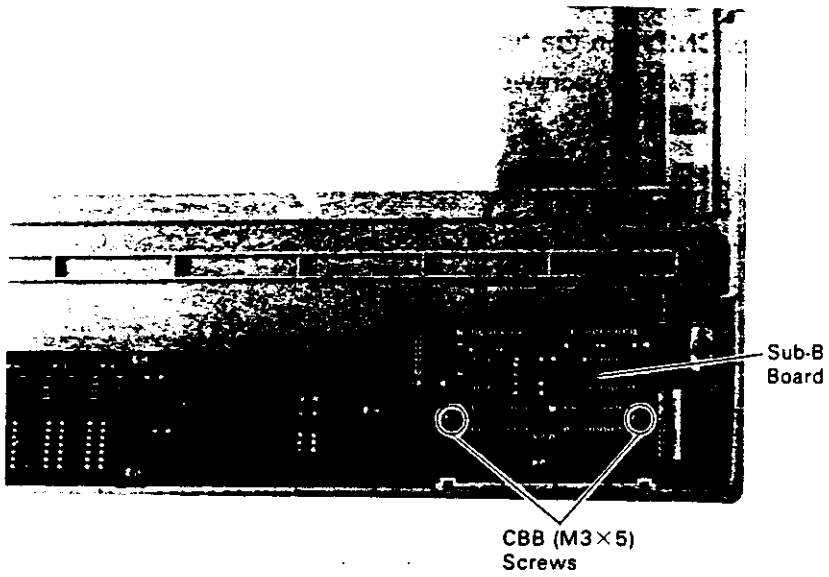


Figure 3-16. Removal of Sub-B Board

[Step 3] Detach connector CN2 from the sub-B board.

3.2.3.6 Removing the Panel Board

[Step 1] Remove the upper housing. [Refer to 3.2.2.1]

[Step 2] Remove the sub-B board. [Refer to 3.2.3.5]

[Step 3] Remove the four CB (M3×6) screws fastening the panel board to the upper housing.

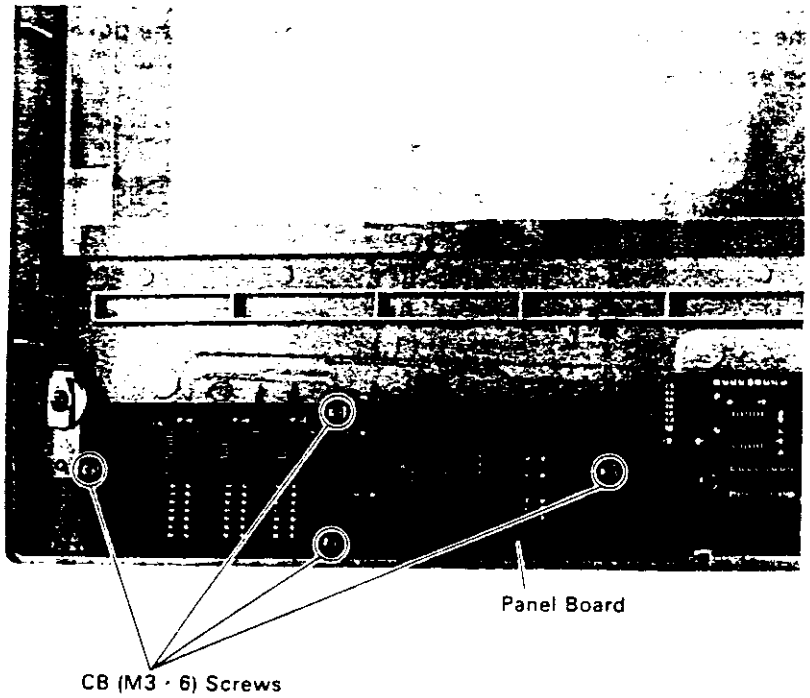


Figure 3-17. Removal of Panel Board

3.2.4 Disassembling the Scanner Engine

This section explains how to disassemble the scanner engine.

3.2.4.1 Removing the Scanner Head

[Step 1] Remove the upper housing. [Refer to 3.2.2.1]

[Step 2] Remove the FFC cover, which is holding the scanner-head FFC in place.

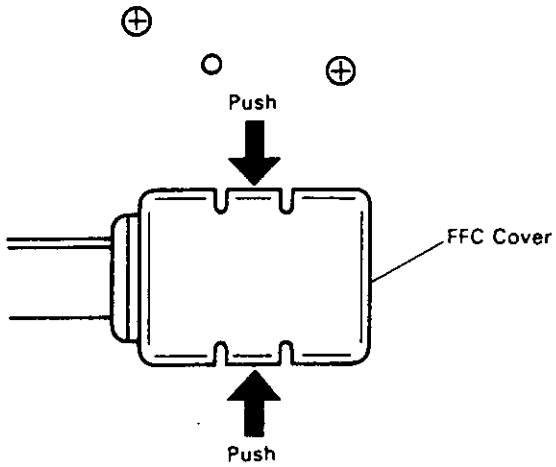


Figure 3-18. Removal of FFC Cover

[Step 3] The scanner-head FFC is connected to the main board by main board connectors CN1 and CN2. Pull the FFC from these connectors.

[Step 4] Remove the two CP(O) (M3×5) screws fastening the lens cover to the scanner head. Then remove the lens cover.

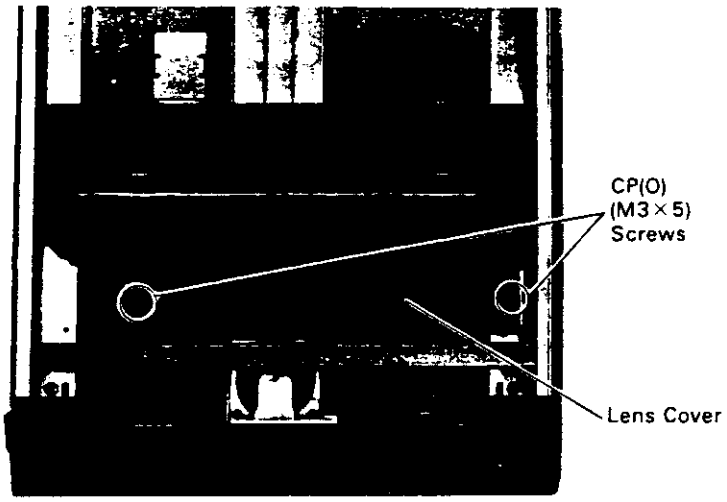


Figure 3-19. Removal of Scanner Head

[Step 5] Remove the CP(O) (M3×5) screw fastening the carriage L metal fitting to the scanner head. The remove the scanner head.

REQUIRED ADJUSTMENT

If you are exchanging the scanner head, be certain to adjust the brightness level. (Refer to Section 4.2.)

3.2.4.2 Removing the Carriage Motor

[Step 1] Remove the attachment screws [Refer to 3.1.1]

[Step 2] Remove the bottom housing. [Refer to 3.2.2.2]

[Step 3] Remove connector CN2 from the power board.

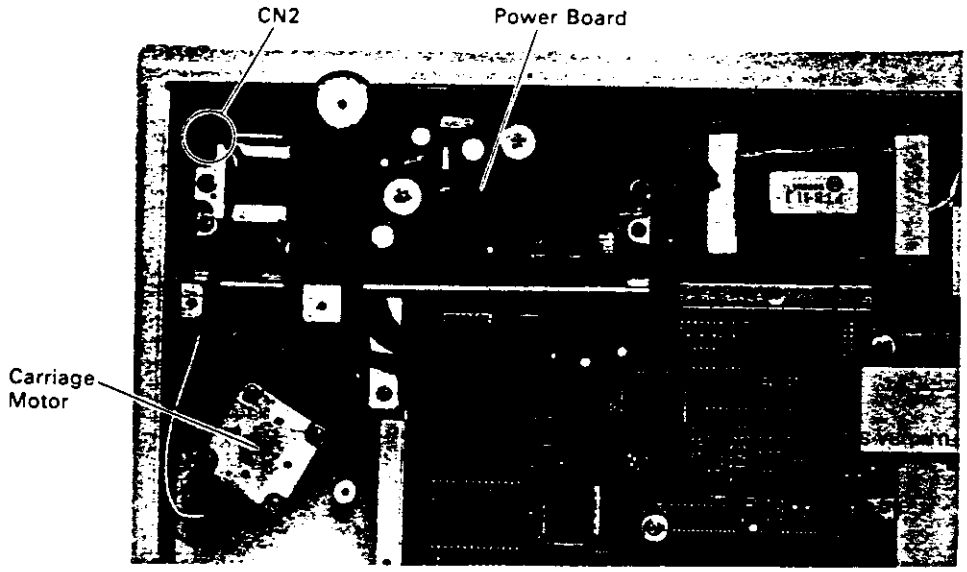


Figure 3-20. Removal of Carriage Motor (1)

[Step 4] Remove the upper housing. [Refer to 3.2.2.1]

[Step 5] Remove the two CC (M3×6) screws fastening the carriage motor to the center rail. Remove the carriage motor.

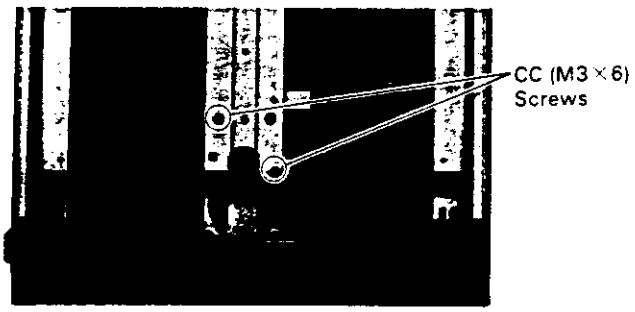


Figure 3-21. Removal of Carriage Motor (2)

REASSEMBLY POINTS

1. When remounting the carriage motor, position it so that the cord is as shown in Figure 3-20.
2. The backlash of the carriage motor pinion gear and the pulley gear should be about 0.01mm. After mounting the carriage motor, move the timing belt by hand to ensure that it moves smoothly.

3.2.4.3 Removing the Home Position Sensor

[Step 1] Remove the upper housing. [Refer to 3.2.2.1]

[Step 2] Remove the connector on the home.position sensor.

[Step 3] Remove the home-position sensor

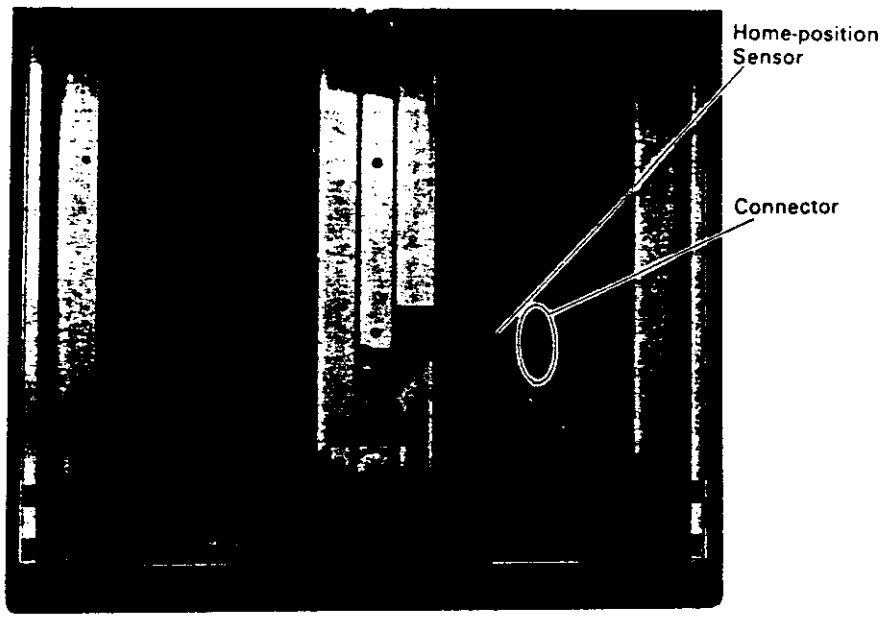


Figure 3-22. Removal of Home Position Sensor

3.2.4.4 Removing the Carriage L Metal Fitting

[Step 1] Remove the upper housing. [Refer to 3.2.2.1]

[Step 2] Remove the scanner head. [Refer to 3.2.4]

[Step 3] Remove the carriage L metal fitting from the timing belt.

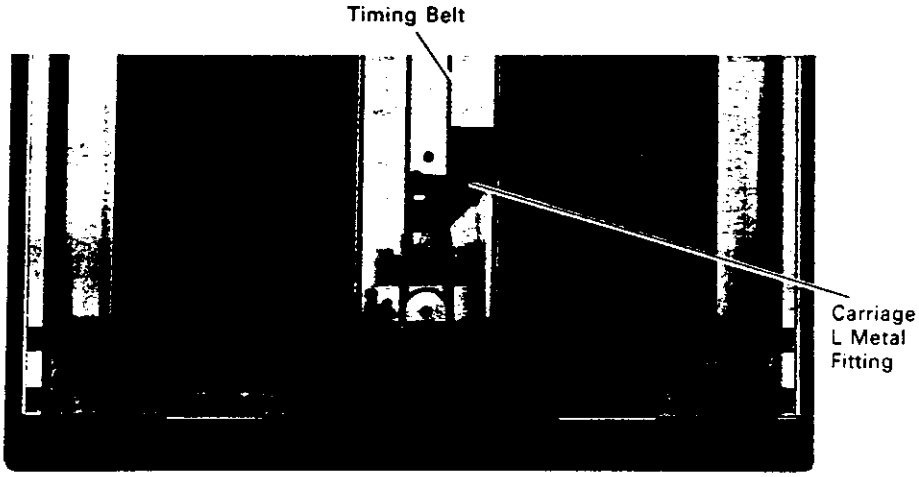


Figure 3-23. Removal of Carriage L Metal Fitting

REASSEMBLY POINT

After remounting the metal fitting onto the belt, use a pliers to flatten the belt-interlocking teeth of the fitting.

3.2.4.5 Disassembling the Scanner Head

[Step 1] Remove the two CP(O) (M3×5) screws fastening the lamp cover to the scanner head frame. Remove the lamp cover.

[Step 2] Remove the shield sheet.

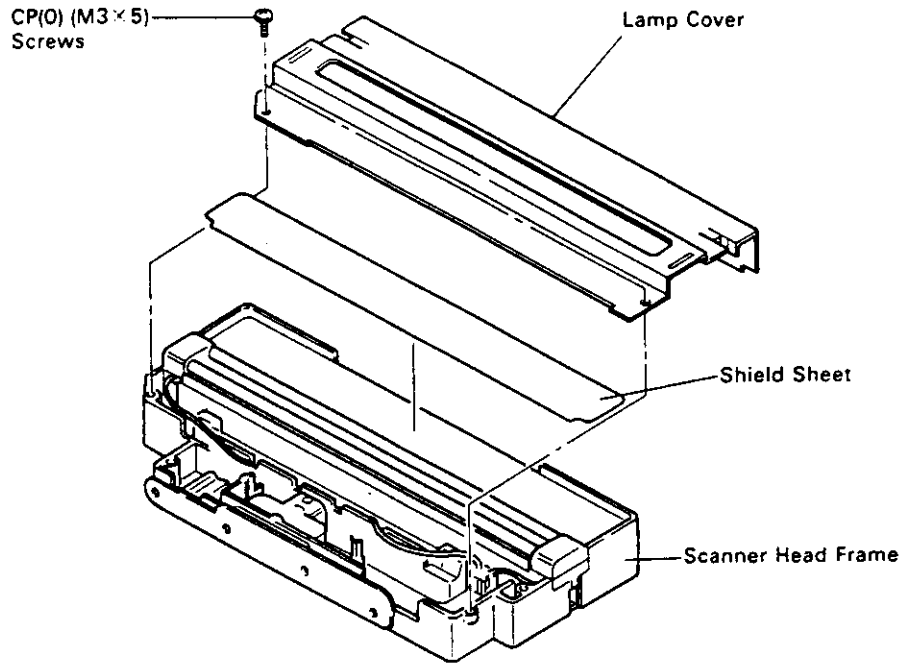


Figure 3-24. Disassembling the Scanner Head (1)

[Step 3] Remove the CC (M3×4) screw fastening the front inverted board to the scanner head frame.

[Step 4] Detach FFC from the connector of rear inverted board.

[Step 5] Remove the rear inverted board, front inverted board, and lamp.

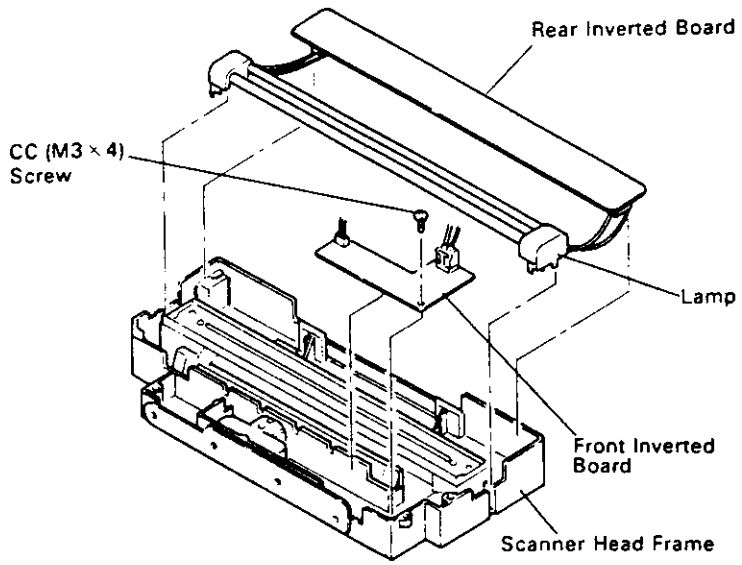


Figure 3-25. Rear Inverted Board, Front Inverted Board, and Lamp

3.2.5 Disassembling the Rear Frame (Removing the Sub-Board)

[Step 1] Remove the upper housing. [Refer to 3.2.2.1]
[Step 2] Remove the sensor head. [Refer to 3.2.4]
[Step 3] Remove the bottom housing. [Refer to 3.2.2.2]
[Step 4] Unplug the AC inlet cord from the power switch. And remove the CB(O) (M4×6) screws.

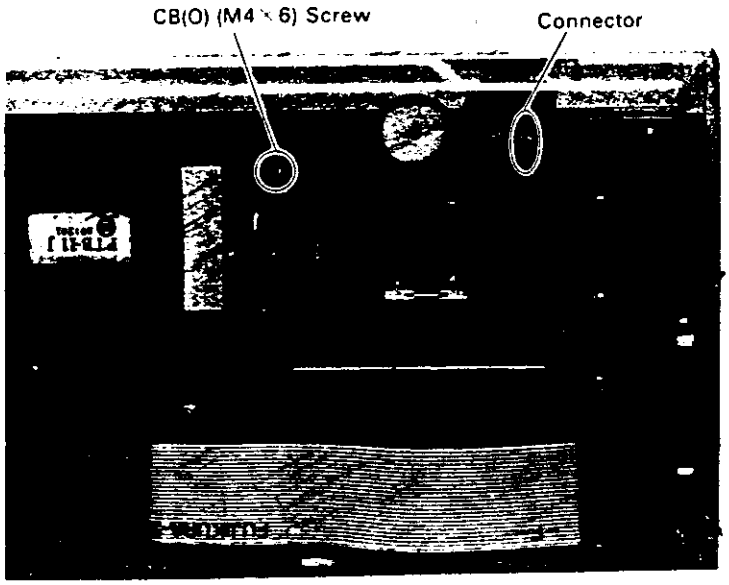


Figure 3-26. Removal of Rear Frame (1)

REASSEMBLY POINT

When reconnecting the cord to the power switch, the switch orientation and cord colors should be as shown below.

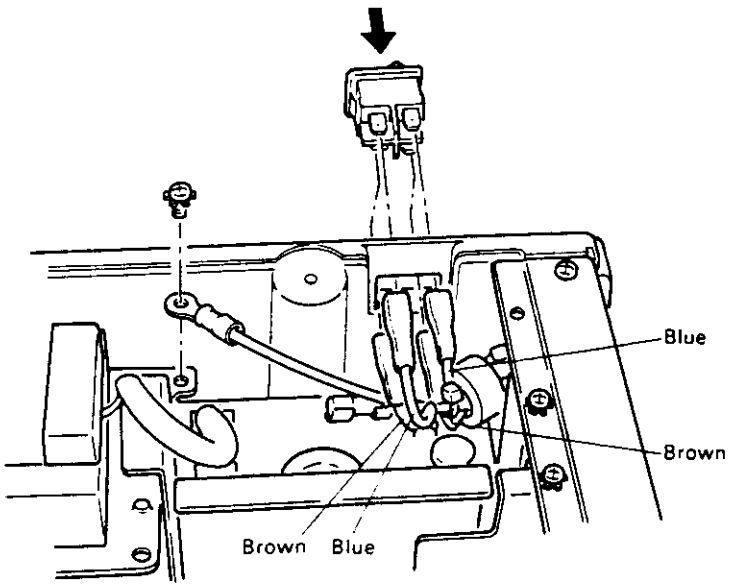


Figure 3-27. Reconnecting the Cord to the Power Switch

[Step 5] Detach connector CN7 from the main board.

[Step 6] Remove the two CC (M3×8) and the two CP(O) (M3×5) screws holding the rear frame in place. Then remove the rear frame.

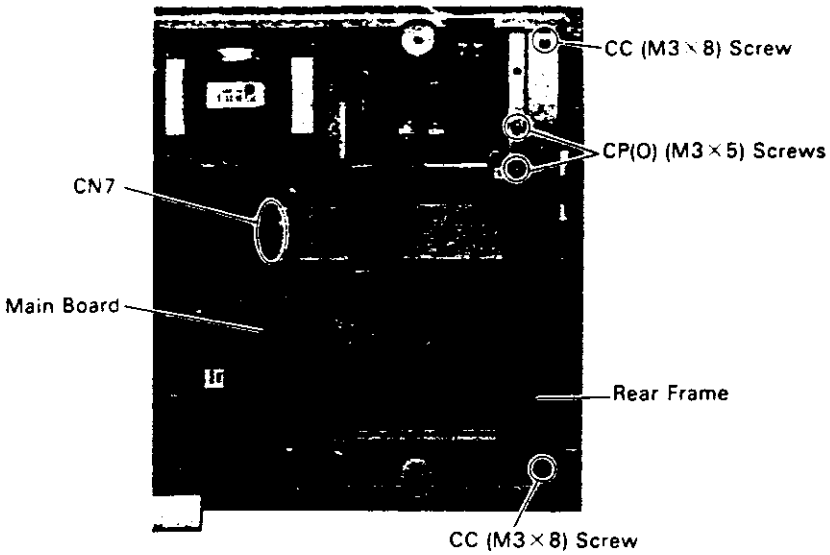


Figure 3-28. Removal of Rear Frame (2)

[Step 7] Remove the screw fixing the RS-232C interface connector.

[Step 8] Remove the two CP (M3×8) screws fastening the sub-board to the rear frame. Then remove the sub.board from the rear frame.

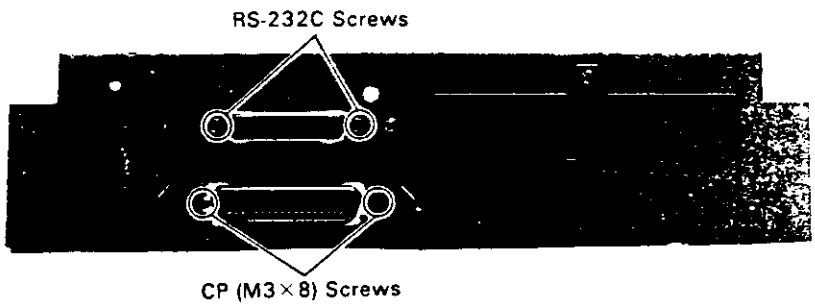


Figure 3-29. Removal of Sub-Board

CHAPTER 4
ADJUSTMENT

LIST OF FIGURES

4.1 ADJUSTMENT OVERVIEW

This section describes the adjustments which must be made when the unit is reassembled. When you replace parts during maintenance or repair work, you must make the adjustments necessary to achieve correct operation of the device.

4.2 BRIGHTNESS ADJUSTMENT

You must always adjust the brightness after exchanging the scanner head or the main board. This involves adjusting the intensity of the fluorescent lamps that constitute the light source in order to establish the white-level (maximum data value) and black-level (minimum data value) for the scanning data. This adjustment must be performed correctly if correct data reading is to be obtained.

Preparation: Remove the stop screw, turn the scanner upside-down, and remove the bottom housing. [Refer to 3.2.2.2.]
You will need a fine minus-type screwdriver to perform the adjustment.

Procedure: According to the flowchart shown in Figure 4-1.

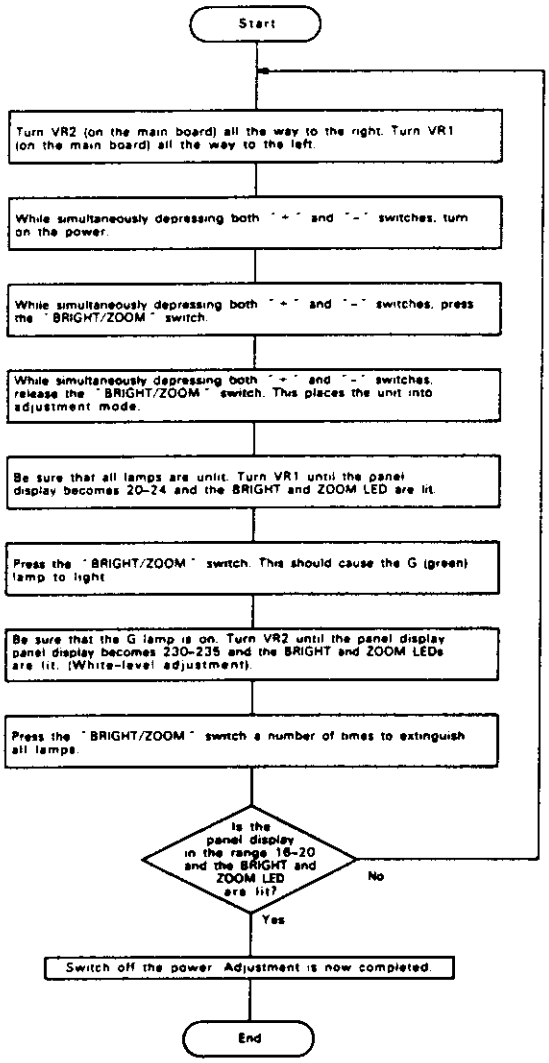


Figure 4-1. Brightness Adjustment Procedure

CHAPTER 5
TROUBLESHOOTING

LIST OF FIGURES

LIST OF TABLES

5.1 OUTLINE

Problems that may occur in the scanner may induce a variety of different symptoms, and this may complicate the task of troubleshooting. Troubleshooting can be simplified by following the flow-charted procedure illustrated in Figure 5-1.

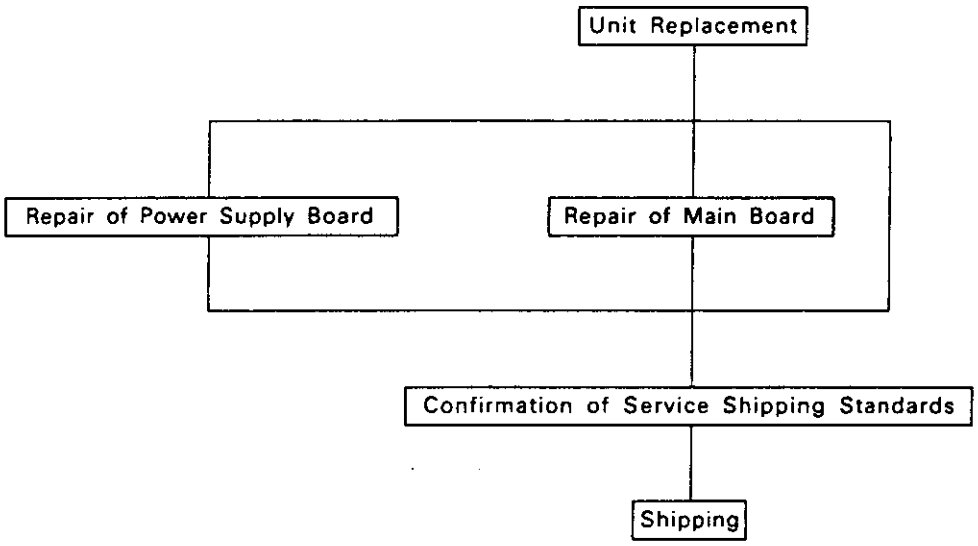


Figure 5-1. Troubleshooting Procedure

The following tables provide troubleshooting information.

Table 5-1. Motor Coil Resistance

Part	Specification
Carriage Motor	Coil resistance 2.7 ohm +/−10% (25 degrees C)

Table 5-2. Error Displays

Error Display	Error	Cause
E-C	Command error	• Undefined command was input. • Incorrect parameter value was used.
E-I	Communication error	• Incorrect communication parameter was used (stop bit, baud, etc.) • Cable is detached or broken. • Operation halted when host did not respond within 30 seconds. • Host-side receiving is disabled (DSR=L).
E-F	System error	• Lamp is out. • Screw is missing. • Main unit is defective.

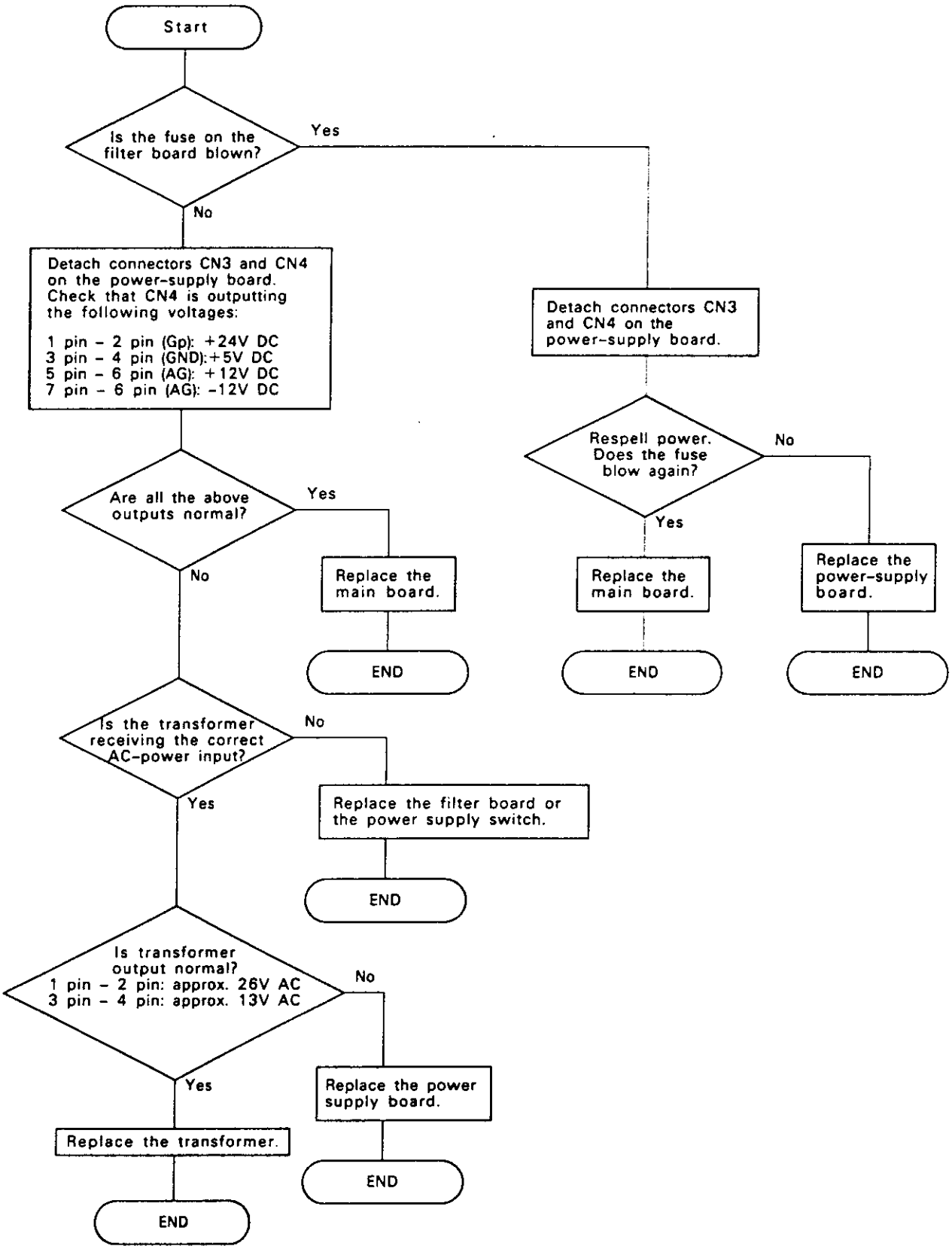
5.2 REPAIR BY UNIT REPLACEMENT

Superficial problems are sufficient to allow you to determine the difficulty at the unit level. Refer to Table 5-3, determine what the problem is, then perform the checks according to the corresponding flow chart.

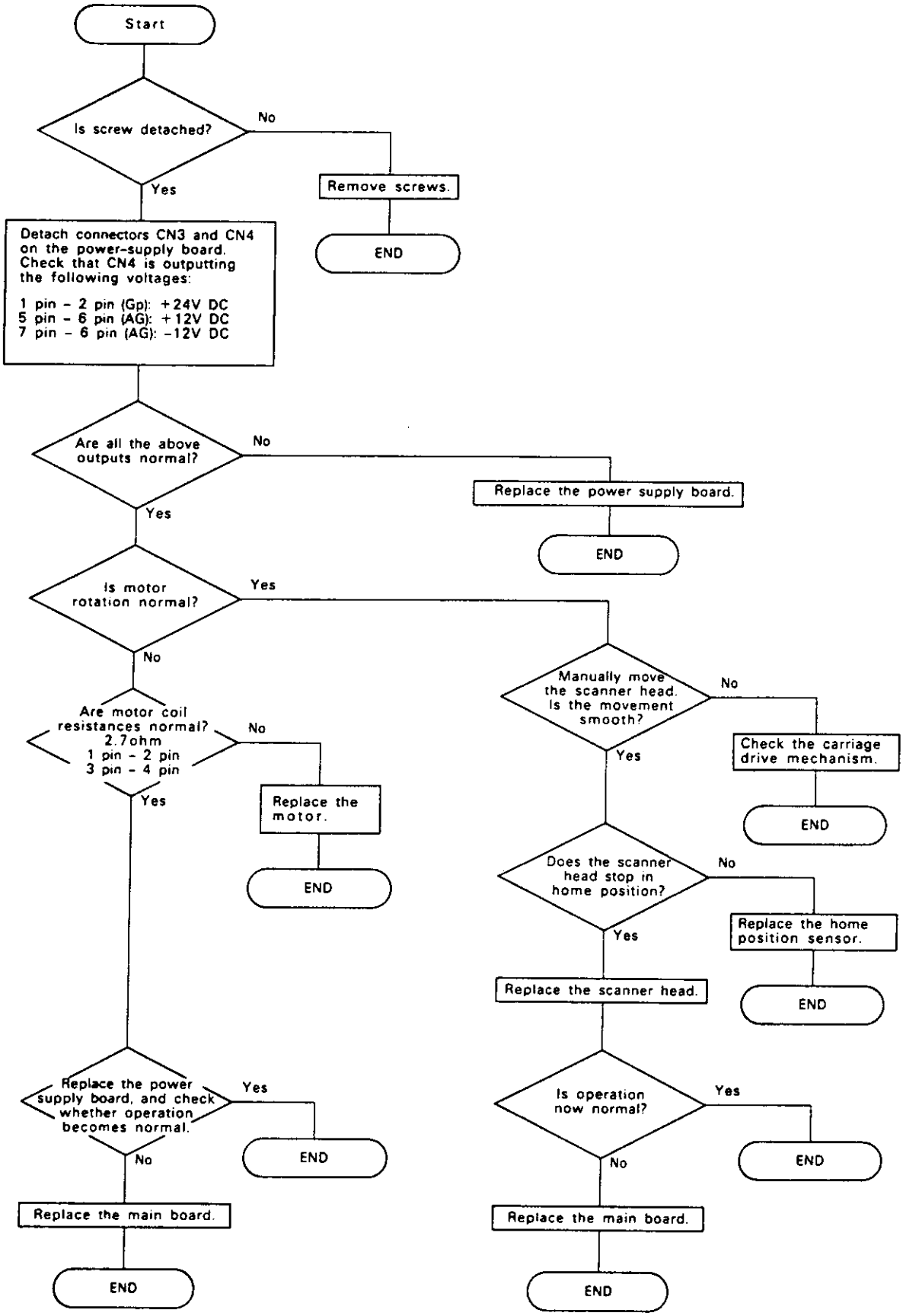
Table 5-3. Symptoms, and Pages to See

Problem	Cause	Refer to This Page
Unit does not operate when power is turned on.	• POWER LED on control panel does not light. • Unit does not begin initialization.	5-3
Error message E-F is displayed, and problem is not corrected by switching power off and then on again.	• Power supply circuit is failing to output +24V DC. • Power supply circuit is failing to output +12V DC and -12V DC. • A screw has become detached. • The carriage motor does not rotate. • Scanner position not stop at home position. • Lamp is out. • White or black standard cannot be read.	5-4
Image is not read cleanly.		5-5
Error message E-I is displayed.	• Interface cable is disconnected or broken. • DIP switches are not being read.	5-6

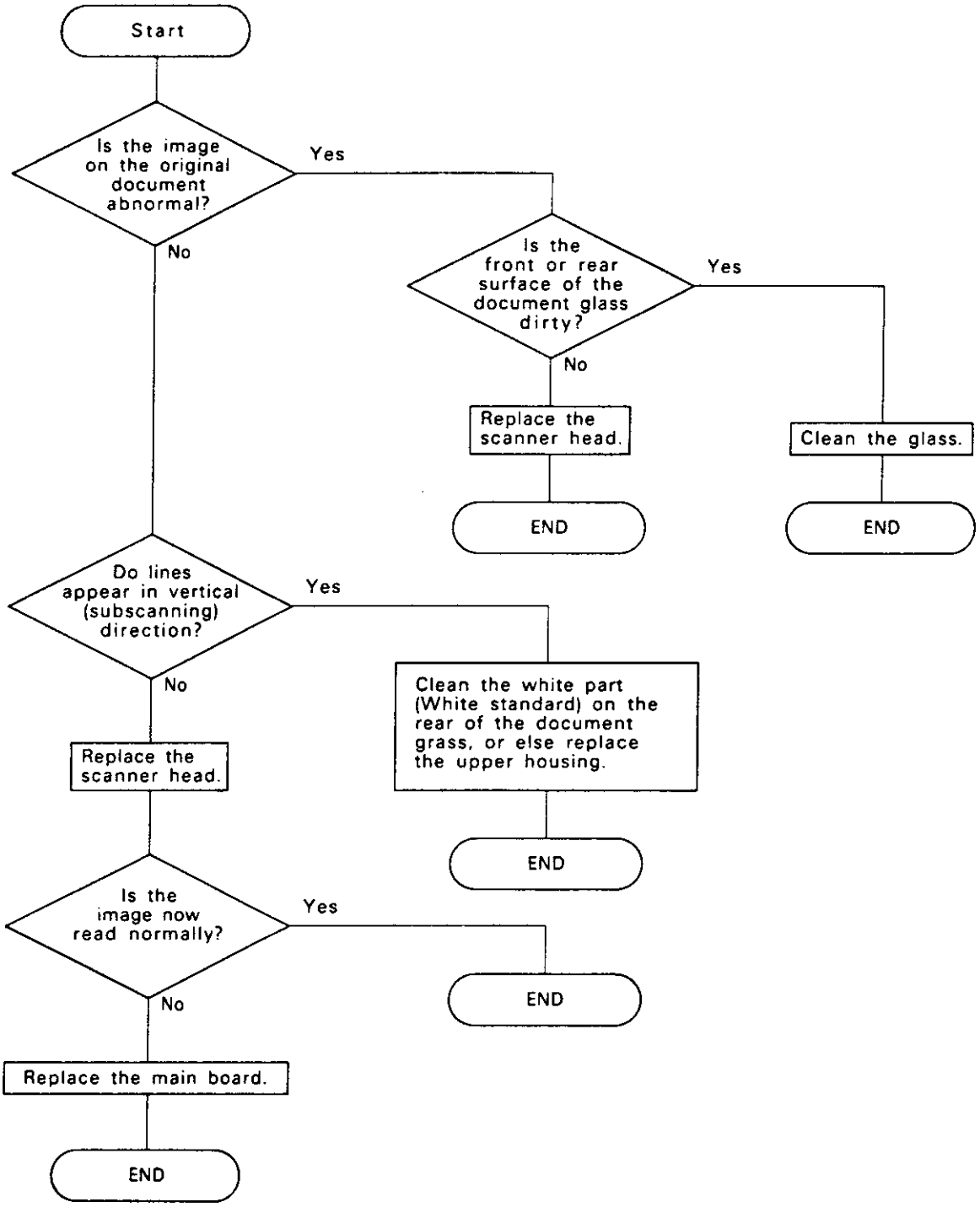
(1) Unit does not operate when power is turned on



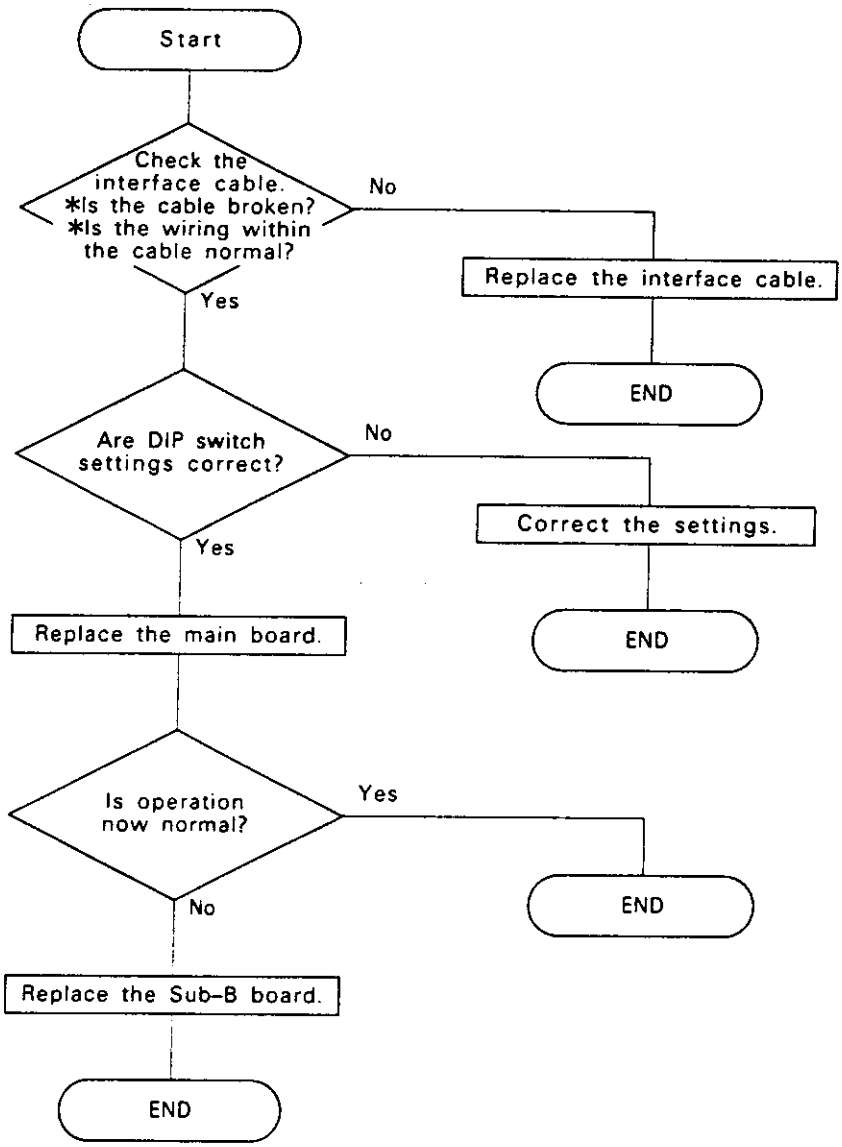
(2) Error message E-F is displayed.



(3) Image is not read cleanly.



(4) Error message E-I is displayed.



5.3 REPAIR OF POWER SUPPLY BOARD

This section provides instructions for repairing a defective power supply board. The section describes various symptoms, likely causes, and checkpoints. Checkpoints refer to proper waveforms, resistance values, and other values which should be checked to evaluate the operation of any potentially bad component. Check these values and take the appropriate action.

Table 5-4. Repair of Power Supply Board

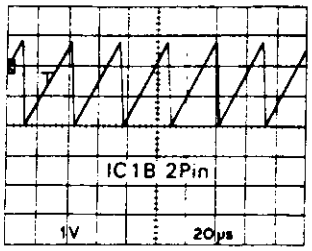
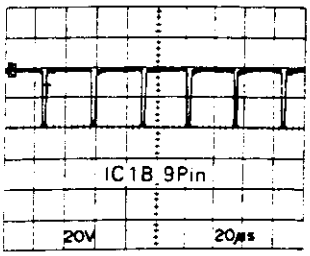
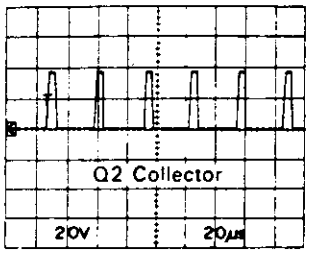
Condition	Cause	Checkpoint	Action
−5V DC is not output.	IC1B is bad.	Check oscillating waveforms and switching waveforms.  	Replace IC1B.
	Transistor Q2 is bad.	Check chopping waveforms. 	Replace transistor Q2.

Table 5-4. Repair of Power Supply Board (Cont.)

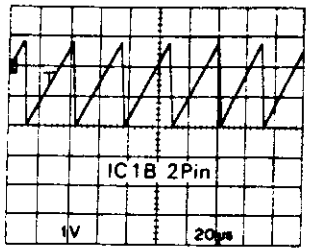
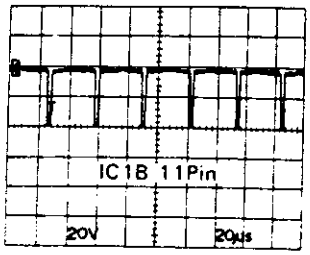
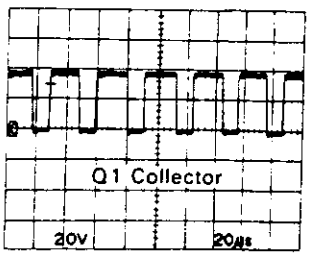
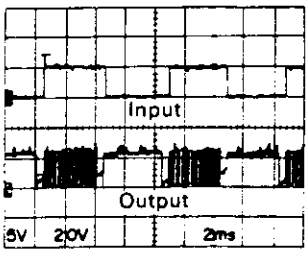
Condition	Cause	Checkpoint	Action
+24V DC is not output.	IC1B is bad.	Check oscillating waveforms and switching waveforms.  	Replace IC1B
	Transistior Q1 is bad.	Check chopping waveforms. 	Replace transistor Q1.

Table 5-4. Repair of Power Supply Board (Cont.)

Condition	Cause	Checkpoint	Action
Carriage motor operation is abnormal.	Transistor Q3 is bad.	Are the IC4B and 4C 11-pin supplying +5V DC?	Replace transistor Q3.
	IC4B is bad or 4C is bad.	Check IC4B or 4C input (8-pin) and output (1 and 15 pins).  	Replace IC4B or 4C.

5.4 REPAIR OF MAIN BOARD

This section provides instructions for repairing a defective main board. The section describes various symptoms, likely causes, and checkpoints. Checkpoints refer to proper waveforms, resistance values, and other values which should be checked to evaluate the operation of any potentially bad component. Check these values and take the appropriate action.

Table 5-5. Repair of Main Board

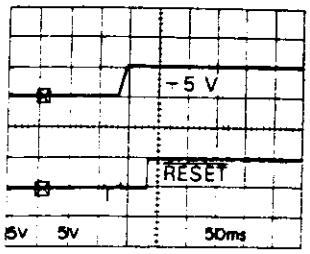
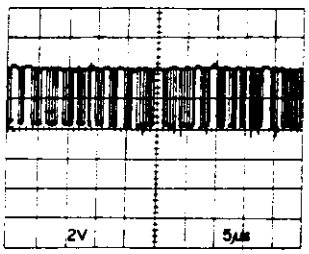
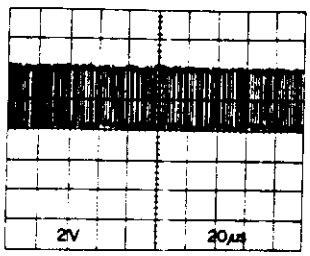
Surface Problem	Condition	Cause	Checkpoint	Action
No operation at all	CPU does not operate.	Reset circuit does not operate.	Check +5V DC voltage and RESET signal.	Replace IC8A.
				
		ROM selection is not carried out correctly.	Is the 15-pin of IC6B correctly going HIGH/LOW?	Replace IC6B.
				
		Defective RAM.		Replace IC6A.
		Defective CPU.	Check waveforms of CPU's 2-pin.	If oscillation is detected, replace the CPU; otherwise replace the CR2.
				

Table 5-5. Repair of Main Board (Cont.)

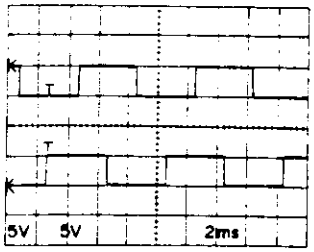
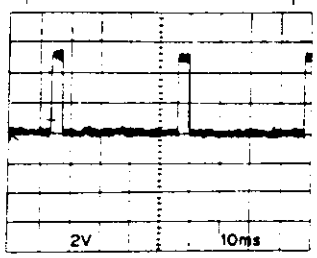
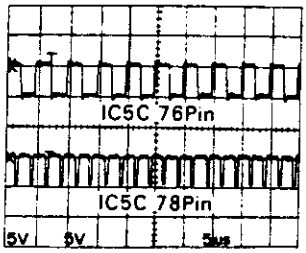
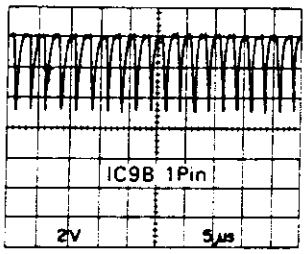
Surface Problem	Condition	Cause	Checkpoint	Action
Error message E-F is displayed.	CR motor not running.	Defective IC1C.	Check output of the 4 and 7 pins of IC1C. 	Replace IC1C.
	Carriage does not stop in home position.	Defective IC1C.	Does the 52-pin input of IC1C go from LOW to HIGH when the carriage enters home position.	If signal changes from LOW to HIGH, replace IC1C.
	Fluorescent lamp does not light.	Defective IC5.	Check switching of the 57, 58, and 59 pins of IC5C. 	Replace IC5C.

Table 5-5. Repair of Main Board (Cont.)

Surface Problem	Condition	Cause	Checkpoint	Action
Error message E-F is displayed.	White standard cannot be read.	Defective IC5C.	Is IC5C outputting the sensor drive signal?	Replace IC5C.
				
		Defective IC9B.	Check I/O of amp IC9B.	Replace IC9B.
				
		Defective SR1.	Is the 1-pin of SR1 outputting +5V DC.	Replace SR1.
		Defective IC9C.		Replace IC9C.
Image is not cleanly read.		Defective image-processing gate array.		Sequentially replace IC1D, 3C, and 5C.
Error message E-I is displayed.	Defective parallel interface circuit.	Defective gate array IC1C.		Replace IC1C.
	Defective serial interface circuit.	Defective IC2B and 2A.		Replace IC2B and IC2A.

CHAPTER 6
MAINTENANCE

LIST OF FIGURES

LIST OF TABLES

6.1 MAINTENANCE

Appropriate measures are required to maintain the device in optimal condition over a long period and to prevent problems. Use a neutral cleaning agent to remove external dirt, and use a vacuum cleaner to remove dust and other debris. Be sure that the document cover glass is free of dirt; dirt on the glass can have a particularly bad influence on the reading quality. If the glass is dirty, clean it with a dry, soft cloth.

NOTE:
Do not use thinner, trichlene, or ketones, as these may cause deterioration of plastic and rubber parts.

6.2 ADHESION

After disassembling the device or exchanging parts, apply adhesive as indicated by Table 6-2. Do not allow adhesive to spread to surrounding parts, as this can adversely affect operation. For this reason, be sure to use only the correct amount of adhesive.

Table 6-1. Adhesive Agent

Type	Name	Volume	Commercial availability	Part No.
Adhesive agent	Neji Lock #2	1000g	Company specific	B730200200

Table 6-2. Adhesion Locations (Refer to Figure 6-1)

Fig. No.	Adhesion location	Number of adhesion points
1	Where the timing belt engages the carriage L metal fitting	1

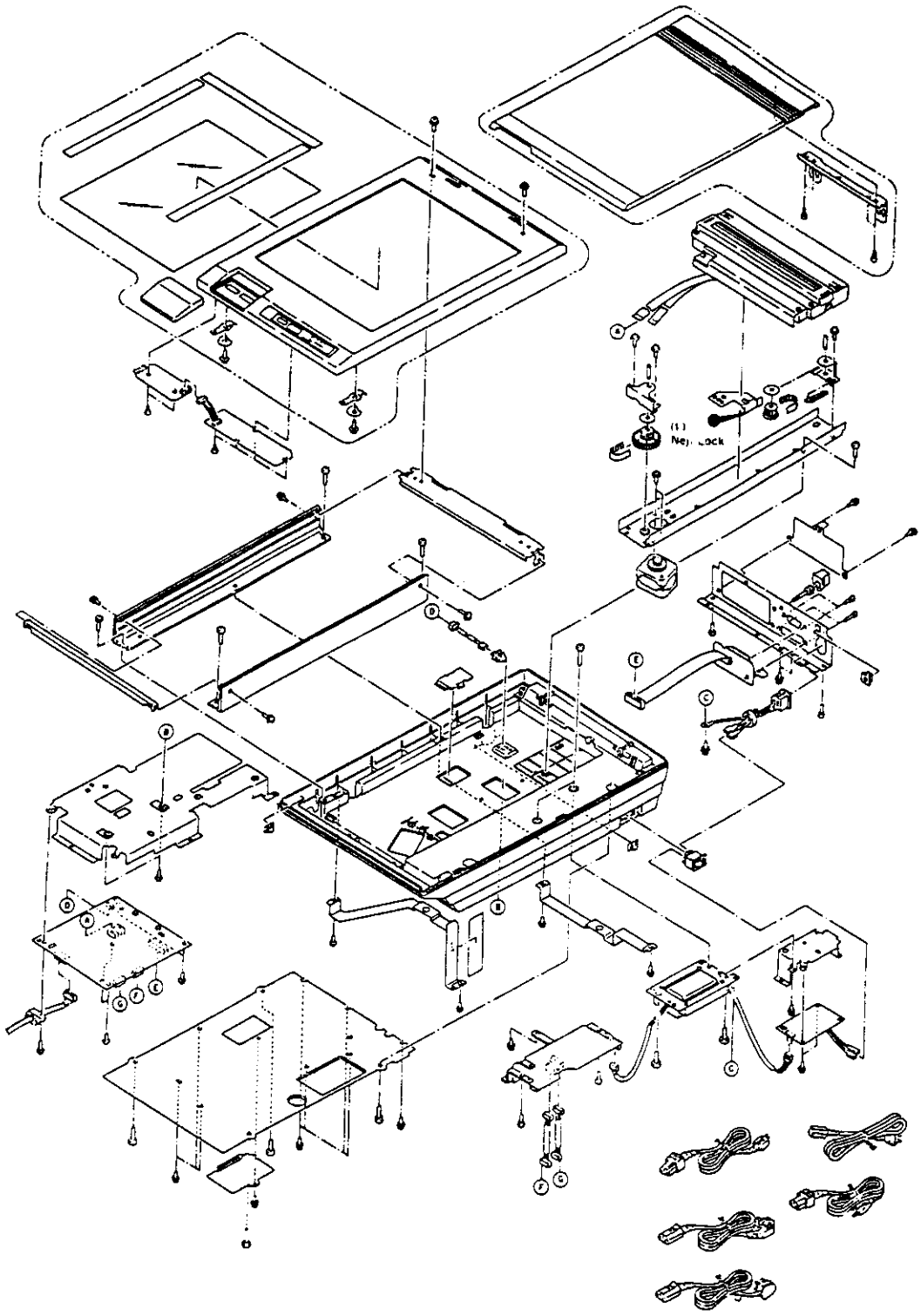


Figure 6-1. Adhesion Diagram

APPENDIX

LIST OF FIGURES

LIST OF TABLES

A.1 CONNECTORS SUMMARY

The interconnection of the primary components is illustrated in Figure A-1 . Table A-1 summarizes the functions and size of the connectors.

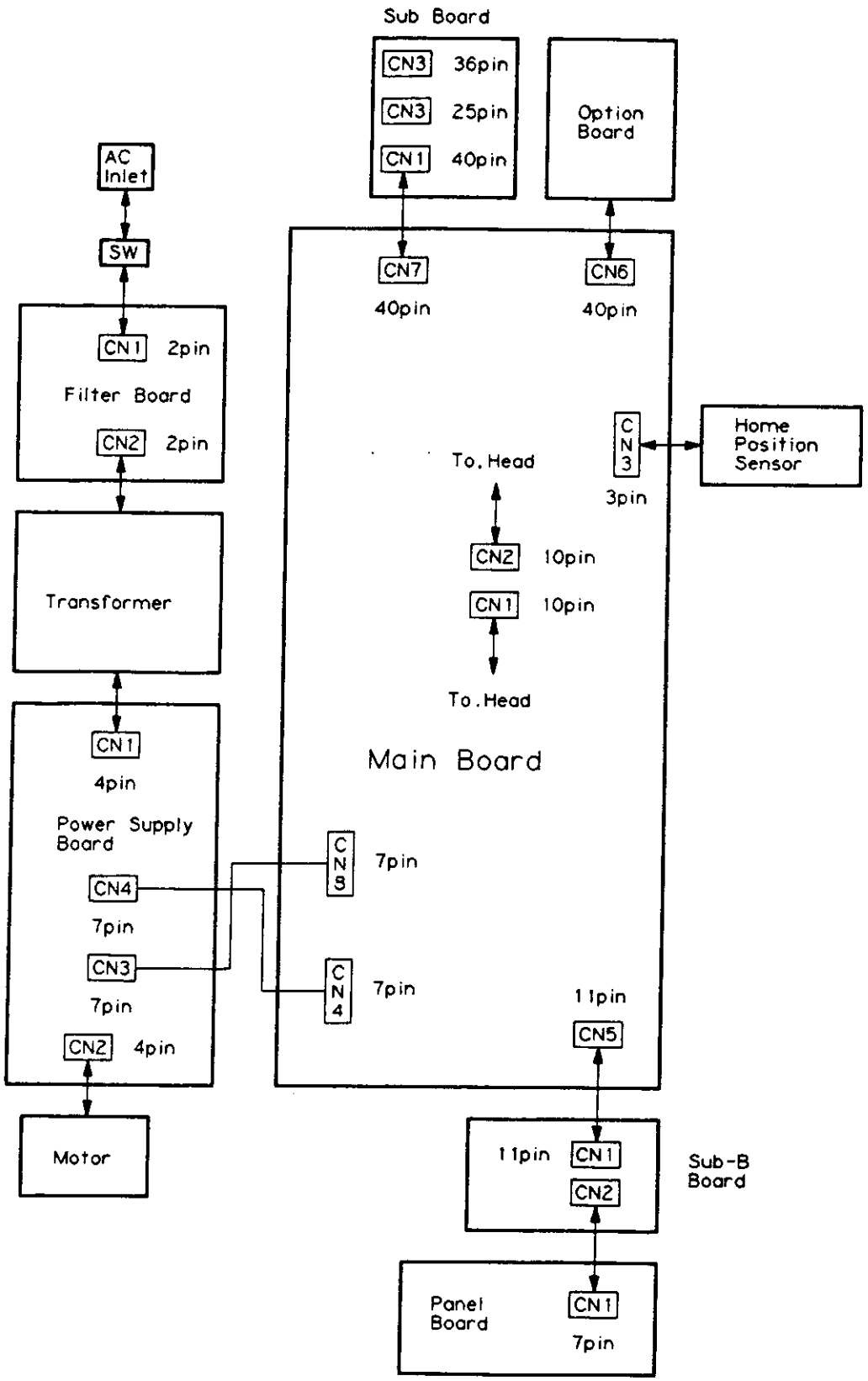


Figure A-1. Cable Connections

Table A-1. Board Connector Summary

Board	Connector	Function	Pins
Main board	CN1	Scanner head	10
	CN2	Scanner head	10
	CN3	Home-position sensor	3
	CN4	DC power input	7
	CN5	Sub-B board	11
	CN6	Option board	40
	CN7	Sub board	40
	CN8	Power supply board (motor phase data)	7
Power supply board	CN1	AC power input	4
	CN2	Carriage motor	4
	CN3	Main board (motor phase data)	7
	CN4	DC power output	7
Filter board	CN1	AC power input	2
	CN2	AC power output	2
Sub board	CN1	Main board	40
	CN2	RS-232C interface	25
	CN3	Parallel interface	36
Sub-B board	CN1	Main board	11
	CN2	Panel board	7
Panel board	CN1	Sub-b board	7

Table A-2. CN1 (Main Board)

No.	I/O	Signal Name	Function
1	O	RS	Scanner head reset
2	O	CK2	Clock 2
3	O	CK1	Clock 1
4	O	SP	Scanner head control
5	—	−12	−12 VDC
6	—	AG	Analog GND
7	—	+12	+12 VDC
8	—	AG	Analog GND
9	I	Vin	Video signal
10	—	GND	GND

Table A-3. CN2 (Main Board)

No.	I/O	Signal Name	Function
1	—	Gp	Power GND
2	—	Gp	Power GND
3	—	+24	+24 VDC
4	O	R	Red lamp control
5	O	B	Blue lamp control
6	O	G	Green lamp control
7	—	+24	+24 VDC
8	—	Gp	Power GND
9	—	Not Used	
10	—	Gp	Power GND

Table A-4. CN3 (Main Board)

No.	I/O	Signal Name	Function
1	I	HP	Home-position sensor
2	—	GND	GND
3	—	+5	+5 VDC

Table A-5. CN4 (Main Board)

No.	I/O	Signal Name	Function
1	—	+24	+24 VDC
2	—	Gp	Power GND
3	—	+5	+5 VDC
4	—	GND	GND
5	—	+12	+12 VDC
6	—	AG	Analog GND
7	—	−12	−12 VDC

Table A-6. CN5 (Main Board)

No.	I/O	Signal Name	Function
1	—	+5	+5 VDC
2	—	+5	+5 VDC
3	—	GND	GND
4	—	GND	GND
5	I	RXS	DIP SW data
6	O	S/L	DIP SW Read Control
7	O	CKS	Clock
8	O	TXS	LED data
9	I	S	BRIGHT/ZOOM SW
10	I	UP	+SW
11	I	DN	−SW

Table A-7. CN6 (Main Board)

No.	I/O	Signal Name	Function
1	I/O	D0	Data bit 0
2	I/O	D1	Data bit 1
3	I/O	D2	Data bit 2
4	I/O	D3	Data bit 3
5	I/O	D4	Data bit 4
6	I/O	D5	Data bit 5
7	I/O	D6	Data bit 6
8	I/O	D7	Data bit 7
9	O	A18	Address bit 18
10	O	A17	Address bit 17
11	O	A16	Address bit 16
12	O	A15	Address bit 15
13	O	A14	Address bit 14
14	O	A13	Address bit 13
15	O	A12	Address bit 12
16	O	A11	Address bit 11
17	O	A10	Address bit 10
18	O	A9	Address bit 9
19	O	A8	Address bit 8
20	O	A7	Address bit 7
21	O	A6	Address bit 6
22	O	A5	Address bit 5
23	O	A4	Address bit 4
24	O	A3	Address bit 3
25	O	A2	Address bit 2
26	O	A1	Address bit 1
27	O	A0	Address bit 0
28	O	RD	Read

Table A-8. CN7 (Main Board)

No.	I/O	Signal Name	Function
29	O	WR	Write
30	O	EXCS	External IC CS
31	I	EXDREQ	External data request
32	I	INIT2	Interrupt 2
33	O	RESET	Reset
34	I	ERD	Judge of option board
35	O	ME	Memory enable
36	—	GND	GND
37	—	GND	GND
38	—	Not used	
39	—	+5	+5 VDC
40	+5	+5 VDC	

Table A-9. CN8 (Main Board)

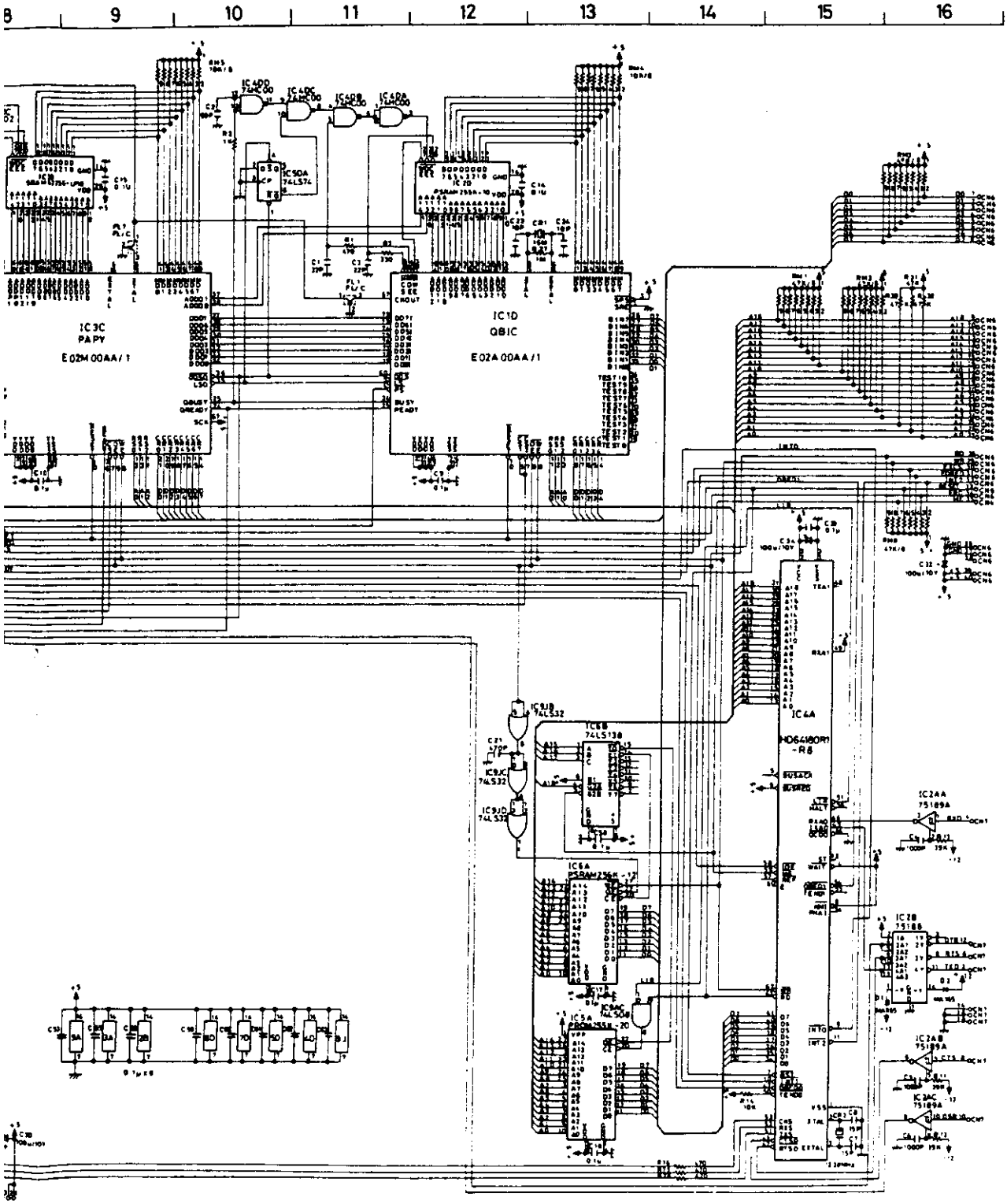
No.	I/O	Signal Name	Function
28	—	AM2	Not used
29	—	1A	Not used
30	—	AM3	Not used
31	—	1B	Not used
32	—	AM4	Not used
33	—	2A	Not used
34	—	AM5	Not used
35	—	2B	Not used
36	—	AM6	Not used
37	—	Gp	Power GND
38	—	+24	+24 VDC
39	—	Gp	Power GND
40	—	+24	+24 VDC

Table A-8. CN7 (Main Board)

No.	I/O	Signal Name	Function
1	—	GND	GND
2	O	TXD	TXD
3	—	GND	GND
4	I	RXD	RXD
5	—	GND	GND
6	O	RTS	RTS
7	O	STRB	Strobe
8	I	CTS	CTS
9	I/O	I/O0	Parallel data bit 0
10	I	DSR	DSR
11	I/O	I/O1	Parallel data bit 1
12	O	DTR	DTR
13	I/O	I/O2	Parallel data bit 2
14	—	GND	GND
15	I/O	I/O3	Parallel data bit 3
16	—	GND	GND
17	I/O	I/O4	Parallel data bit 4
18	—	GND	GND
19	I/O	I/O5	Parallel data bit 5
20	O	ACK	Acknlg
21	I/O	I/O6	Parallel data bit 6
22	O	BUSY	Busy
23	I/O	I/O7	Parallel data bit 7
24	I	INIT	INIT
25	I	DIR	DIR
26	—	AM0	Not used
27	—	AM1	Not used

Table A-9. CN8 (Main Board)

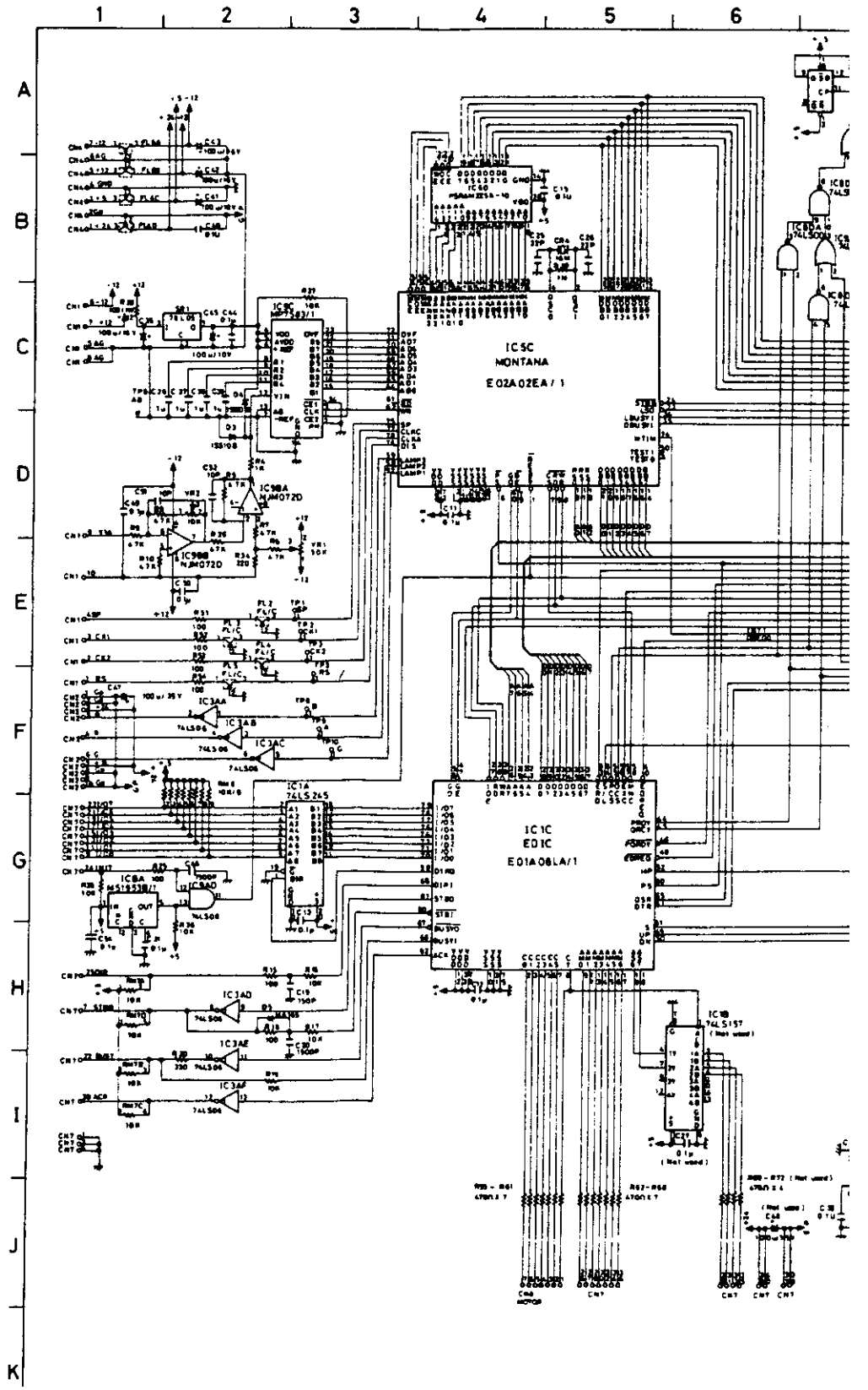
No.	I/O	Signal Name	Function
1	O	CONT	CONT
2	O	Phb	Phb
3	O	I1b	I1b
4	O	I0b	I0b
5	O	Pha	Pha
6	O	I1a	I1a
7	O	I0a	I0a



Main Board 2000518

Main Board Circuit Diagram

REV.-A


1
2
3
4
5
6
A
B
C
D
E
F
G
H
I
J
K
IC5C
MONTANA
E02A02EA / 1
IC1C
EDIC
E01A06LA/1
IC1A
74LS245
IC9A
NJM072D
IC9B
NJM072D
IC3AA
IC3AB
IC3AC
IC3AD
IC3AE
IC3AF
IC8A
IC8B
IC1B
74LS157

A.2 CIRCUIT DIAGRAM

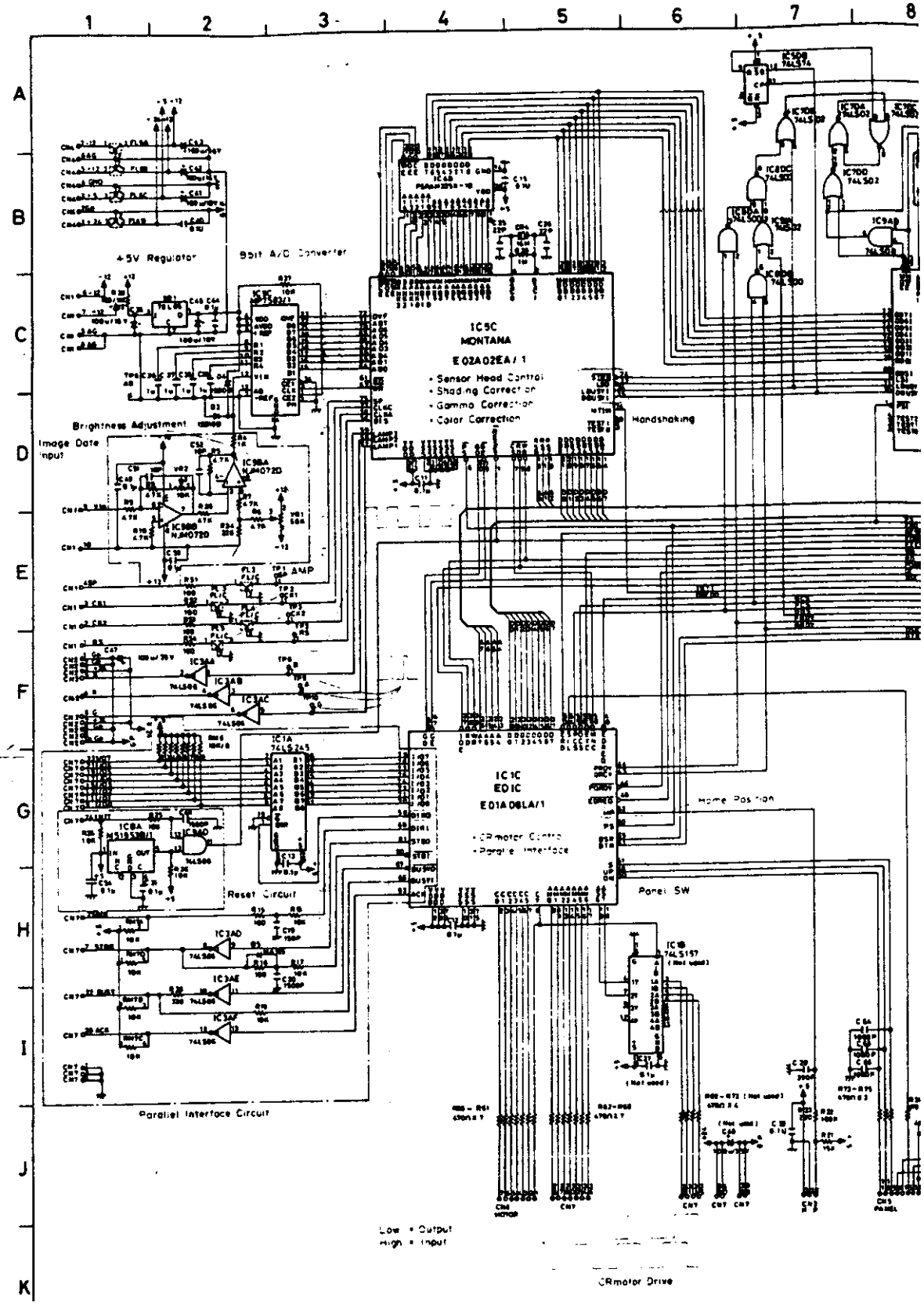
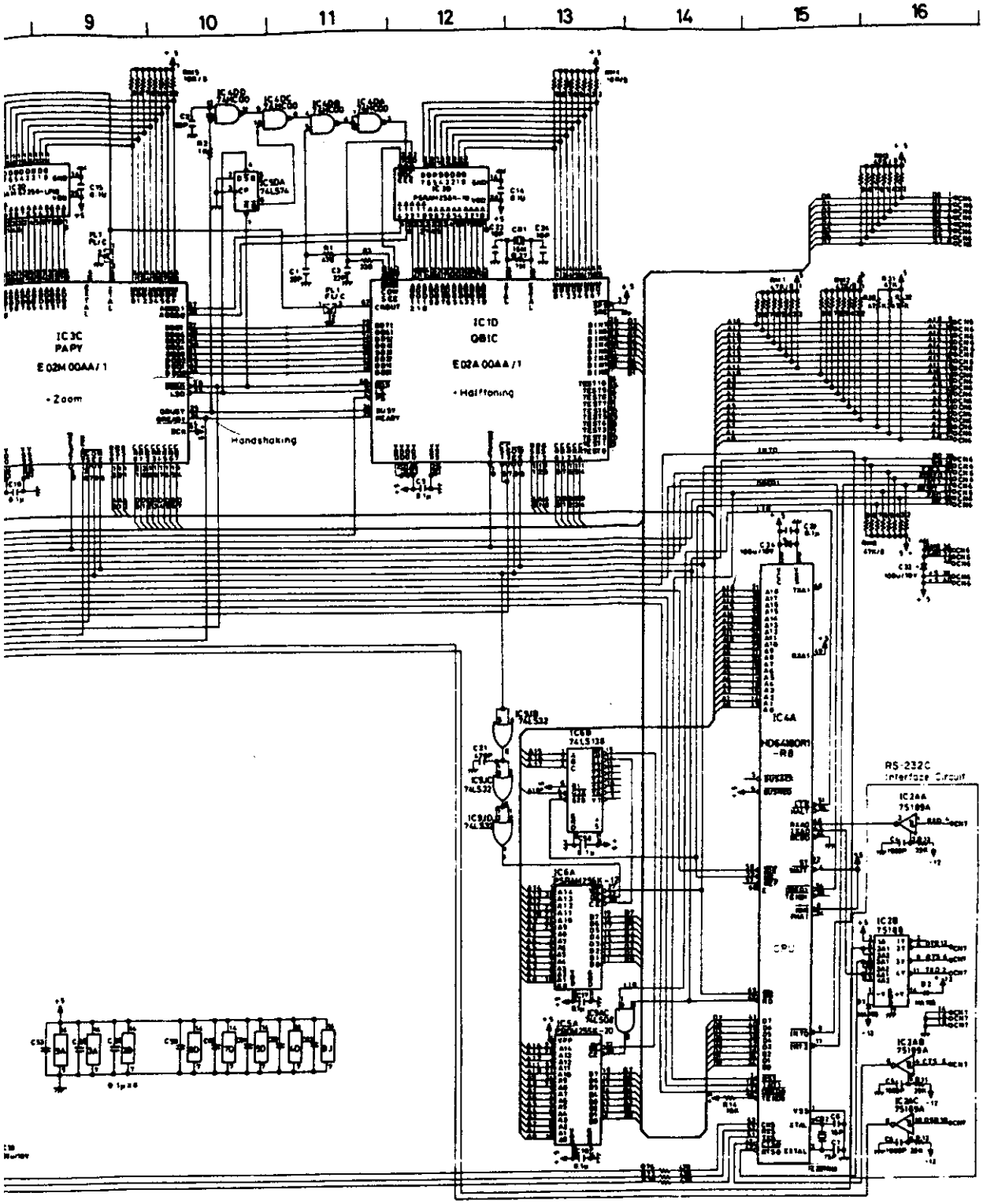


Figure A-2. Main



Main Board 2000518

oard Circuit Diagram (with Note)

A-5

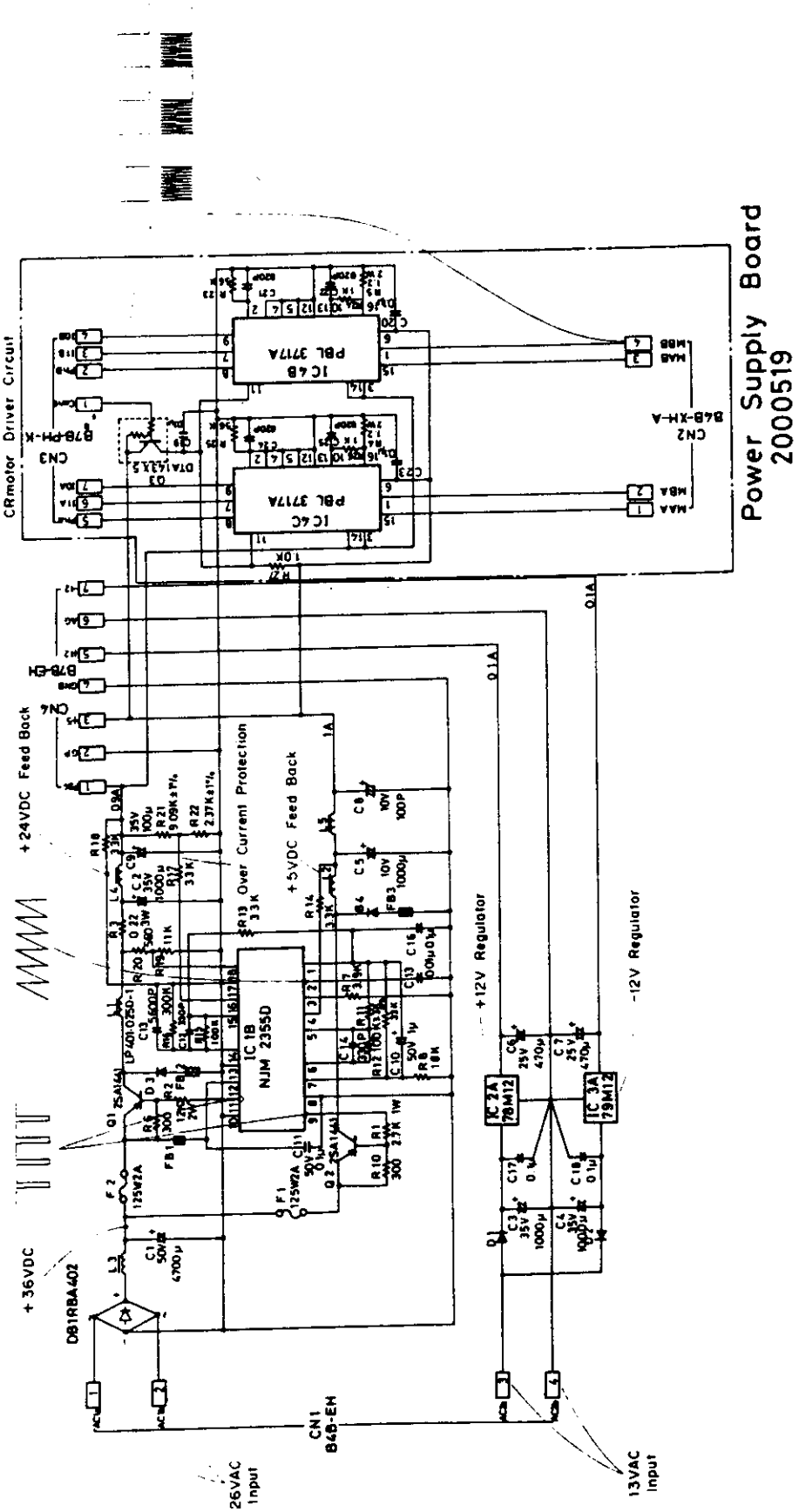


Figure A-4. Power Supply Board Circuit Diagram (with Note)

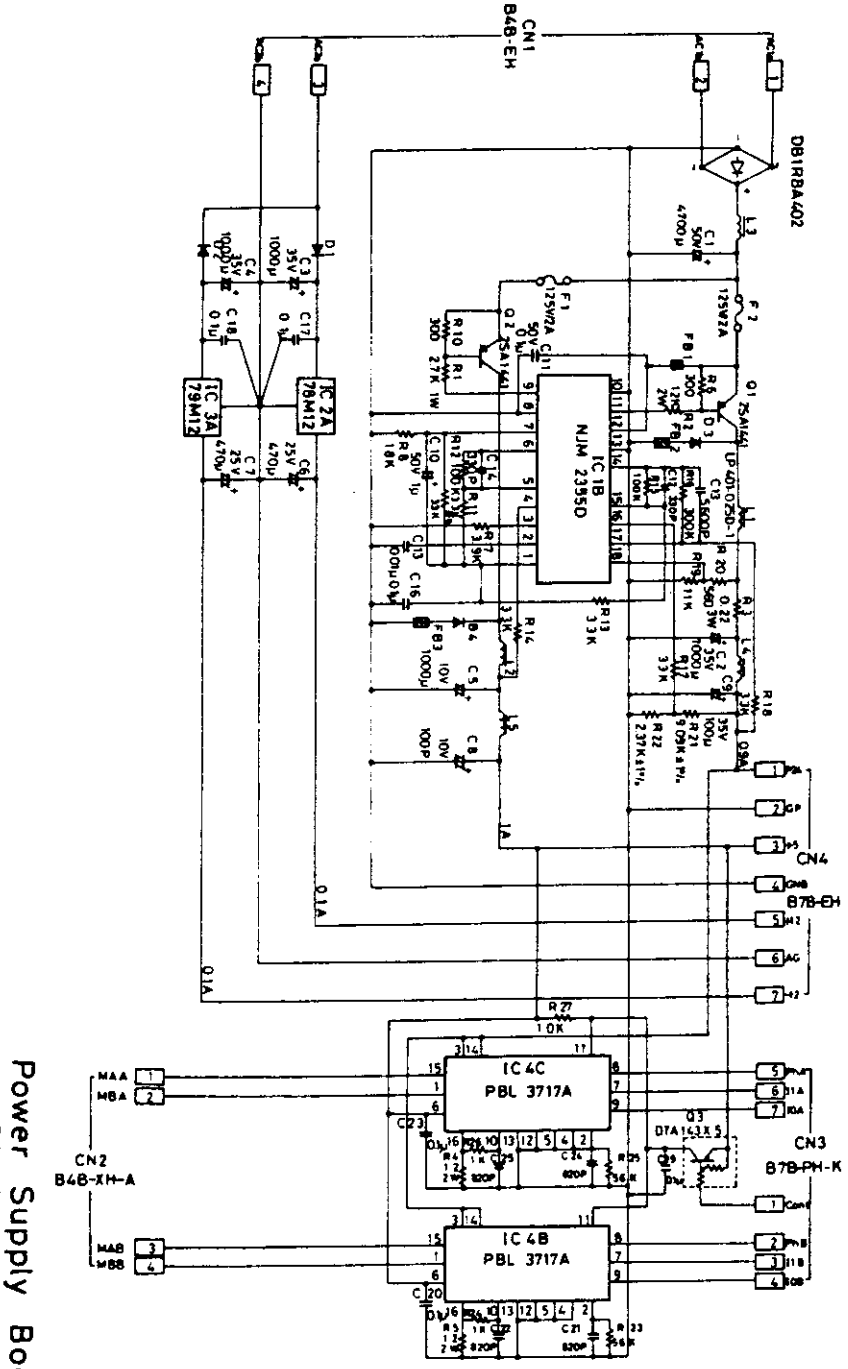
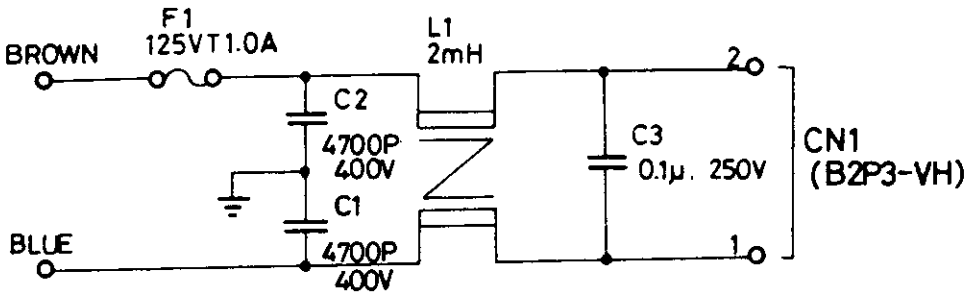
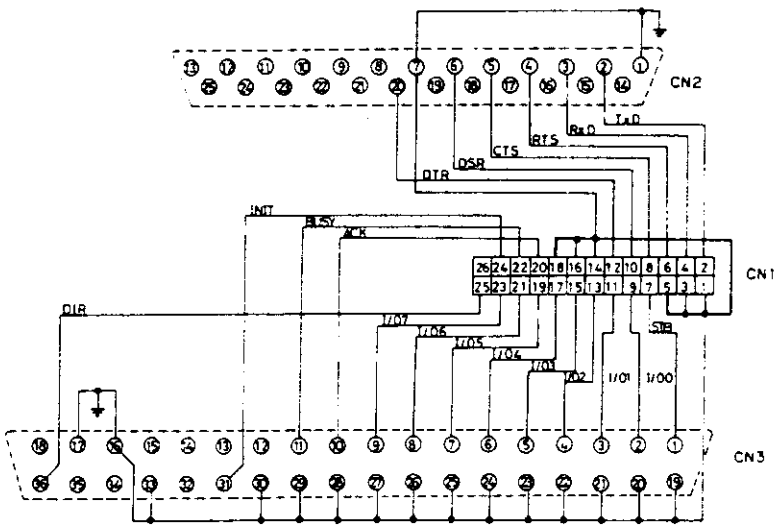


Figure A-5. Power Supply Board Circuit Diagram



Filter Board
2000520

Figure A-6. Filter Board Circuit Diagram



Sub Board
2000521

Figure A-7. Sub Board Circuit Diagram

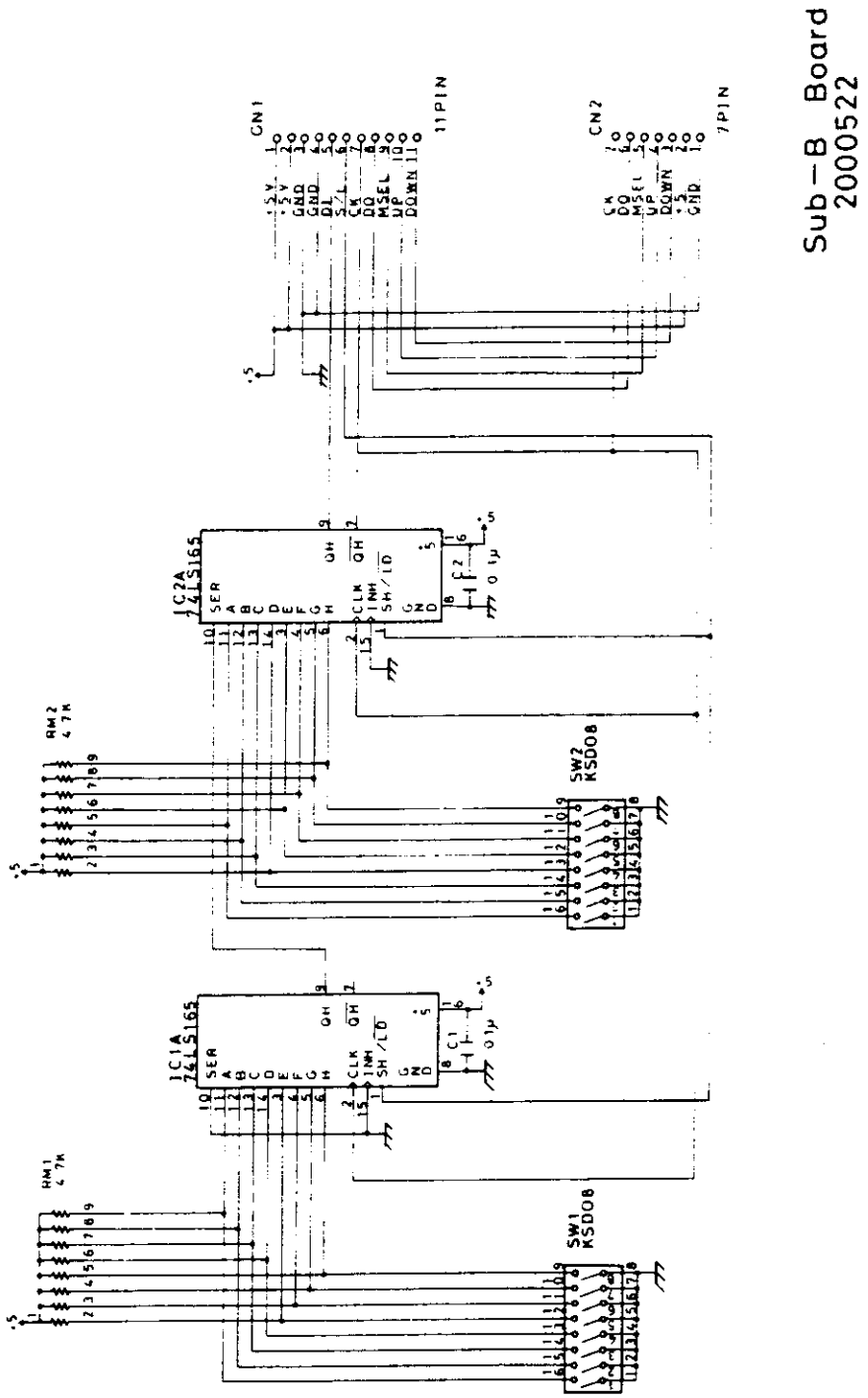


Figure A-8. Sub-B Board Circuit Diagram

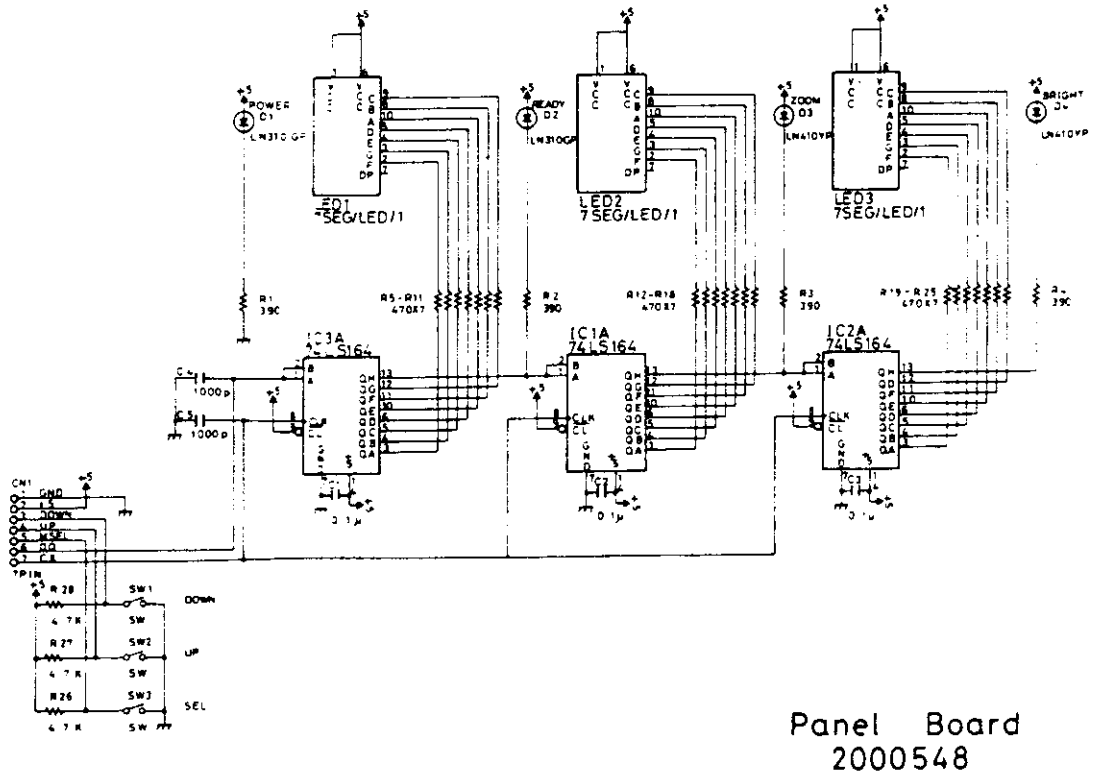
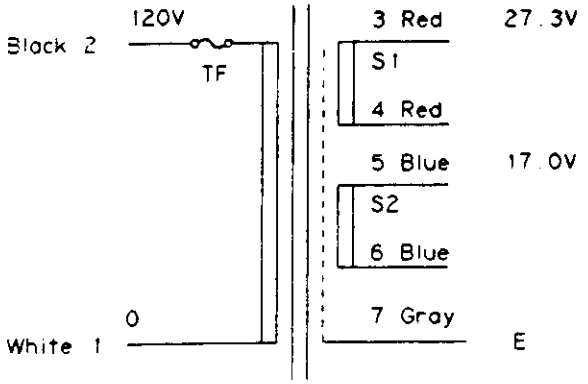
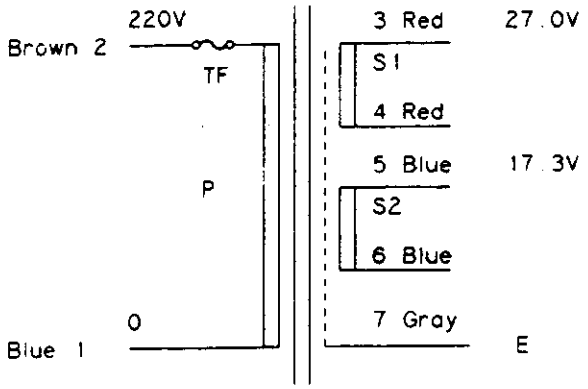


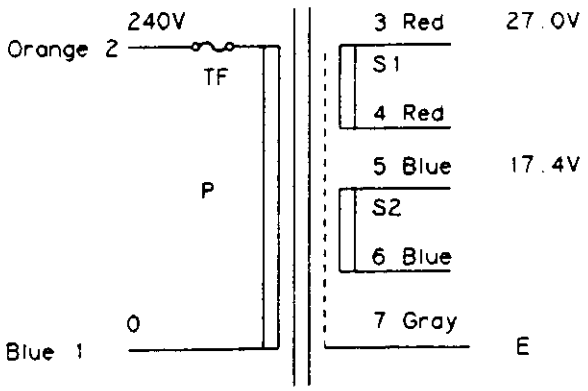
Figure A-9. Panel Board Circuit Diagram



(120V Ver.)



(220V Ver.)



(240V Ver.)

Figure A-10. Transformer Circuit Diagram

A.3 CIRCUIT BOARD COMPONENT LAYOUT

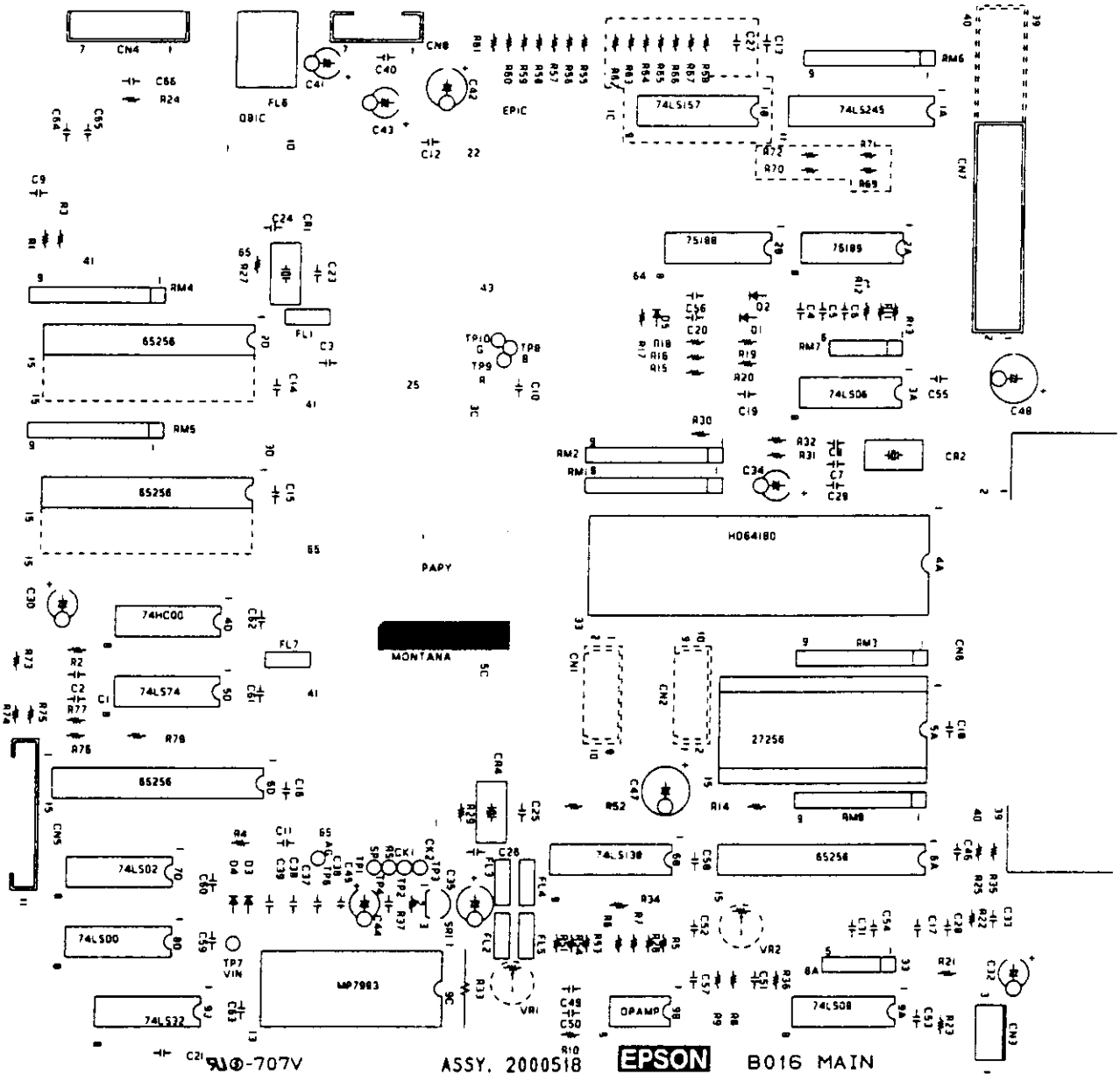


Figure A-11. Main Board Component Layout

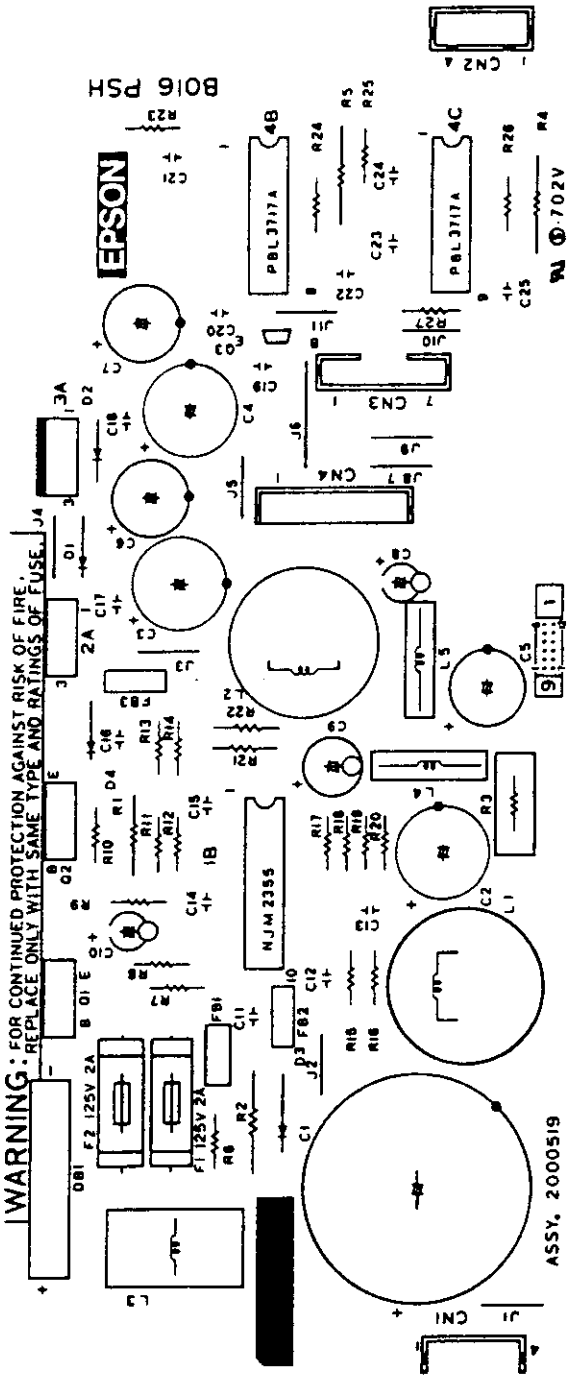


Figure A-12. Power Supply Board Component Layout

A.4 EXPLODED DIAGRAM

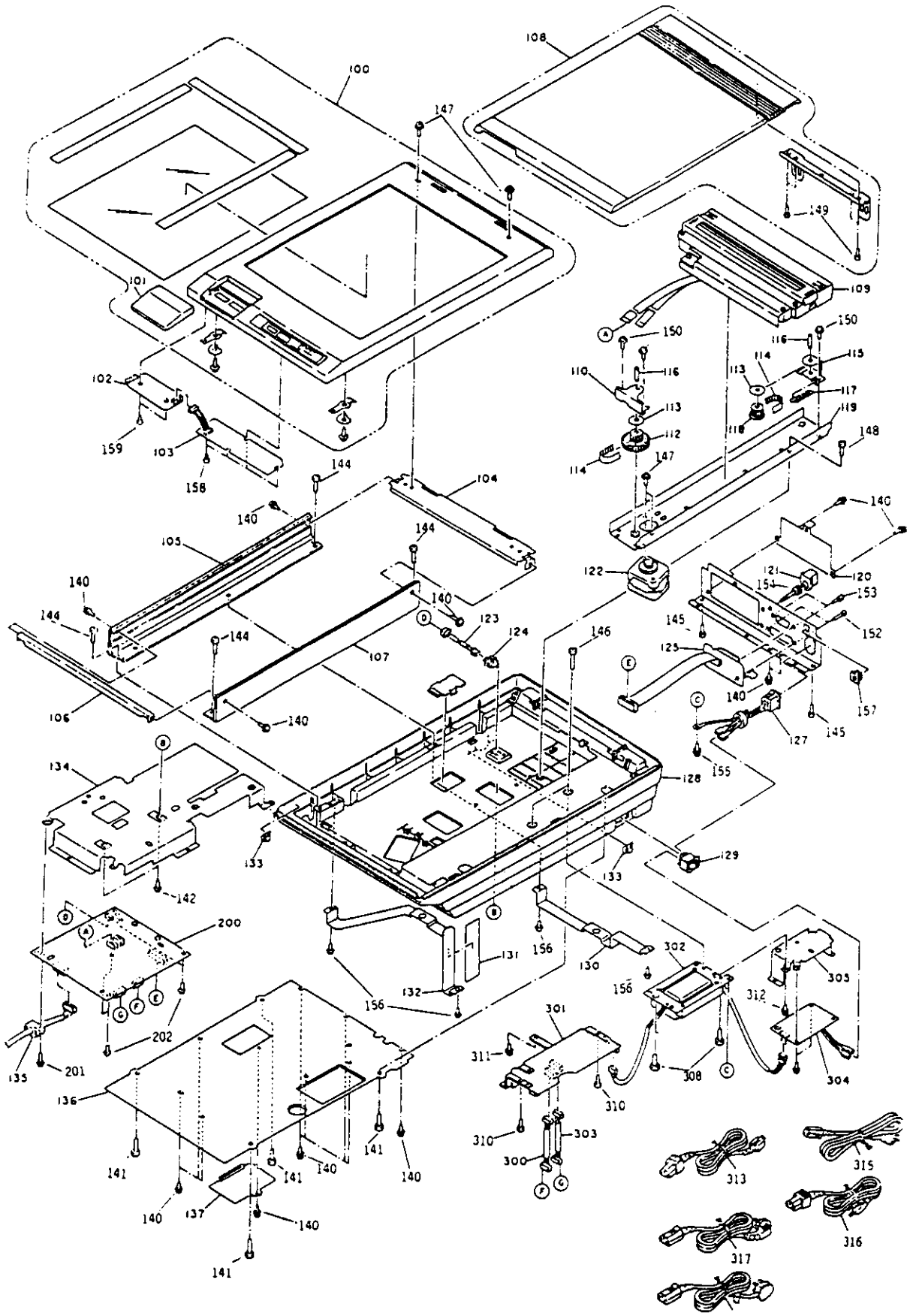


Figure A-13. GT-6000 Exploded Diagram

Table A-10. Part No. Reference Table

Ref. No.	Description	Ref. No.	Description
100	HOUSING ASSEMBLY, UPPER	146	C.P. SCREW
101	COVER, DIP SWITCH	147	C.S. SCREW
102	BOARD ASSY., SUB	148	C.B.T. SCREW
103	BOARD ASSY., PANEL	149	C.P.S. SCREW
104	FRAME, REAR	150	CUP SCREW
105	RAIL, LEFT	152	C.P.S. SCREW
106	FRAME, FRONT	153	CONNECTOR LOCK UNIT
107	RAIL, RIGHT	154	SCREW, PHOTORANSFER
108	COVER ASSEMBLY, MANUSCRIPT	155	C.P.O. SCREW
109	CARRIAGE ASSEMBLY	156	C.P.O. SCREW
110	HOLDER, DRIVE PULLEY	157	GROMMET SCREW
111	PIN, PULLEY, LOCATE, FRONT	158	C.B.B. SCREW
112	PULLEY, CARRIAGE	159	C.B.B. SCREW
113	BEARING	200	BOARD ASSY., MAIN
114	TIMING BELT	300	WIRE HARNESS
115	HOLDER, DRIVE, PULLEY	301	BOARD ASSY., POWER SUPPLY
116	PIN, PULLEY, LOCATE, REAR	302	POWER TRANSFORMER
117	EXTENSION SPRING, 1250	303	WIRE HARNESS
118	DRIVE PULLEY	304	BOARD ASSY., FILTER
119	RAIL, MIDDLE	305	GRANDING PLATE, FILTER
120	OPTION COVER PLATE	308	C.T.B. SCREW
121	CLAMP, PHOTO TRANSFER	309	CUP SCREW
123	WIRE HARNESS	310	C.C.T. SCREW
124	HOME POSITION SENSOR	311	C.P.O. SCREW
125	BOARD, ASSY., SUB	312	C.P.O. SCREW
126	FRAME, REAR	314	POWER CABLE
127	WIRE HARNESS	315	POWER CABLE
128	HOUSING, LOWER	316	POWER CABLE
129	POWER SWITCH	317	POWER CABLE
130	GRANDING PLATE, REAR		
131	SHEET, SHIELD, GROUNDING PLATE		
132	GROUNDING PLATE, FRONT		
133	CK CLAMP		
134	FRAME, SHIELD		
135	WIRE HARNESS		
136	HOUSING, BOTTOM		
137	HOUSING BOTTOM		
140	C.P.O. SCREW		
141	C.T.B. SCREW		
142	CUP SCREW		
144	C.P. SCREW		
145	C.C.T. SCREW		

A.5 CASE OUTLINE DRAWING

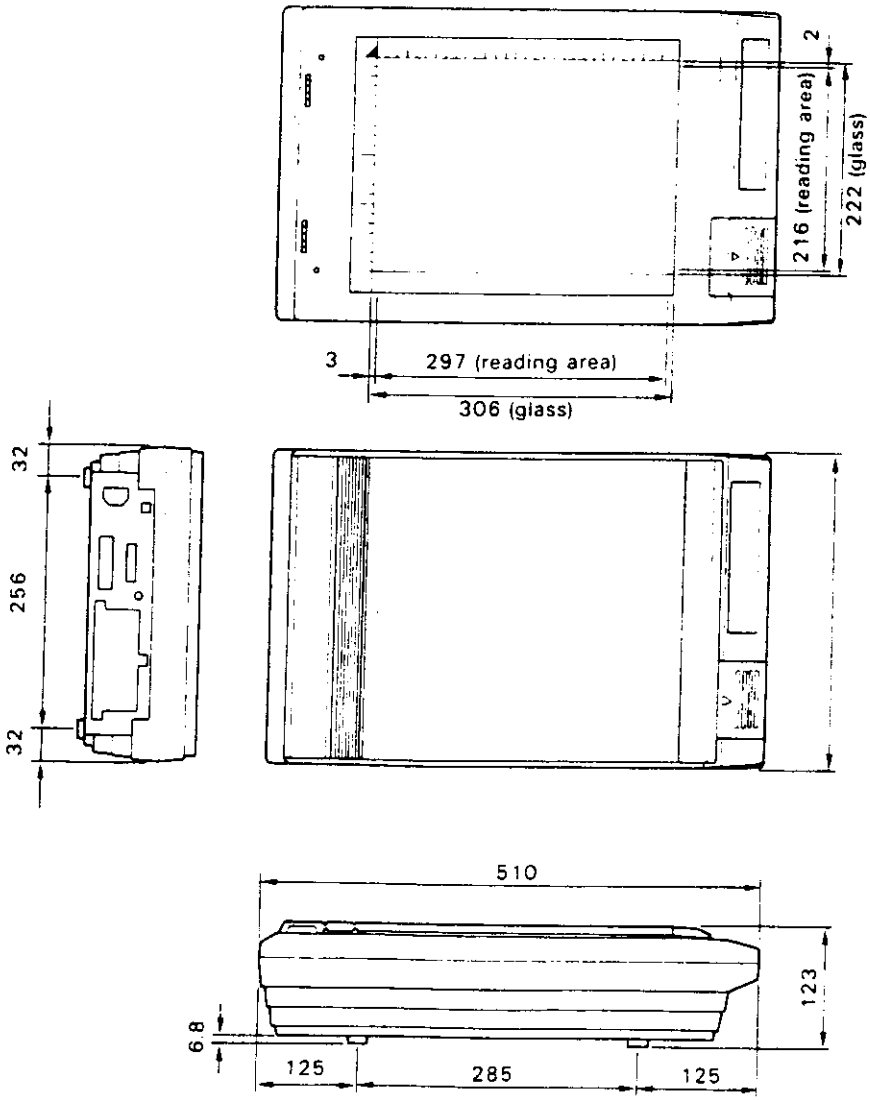


Figure A-14. GT-6000 Case Outline Drawing

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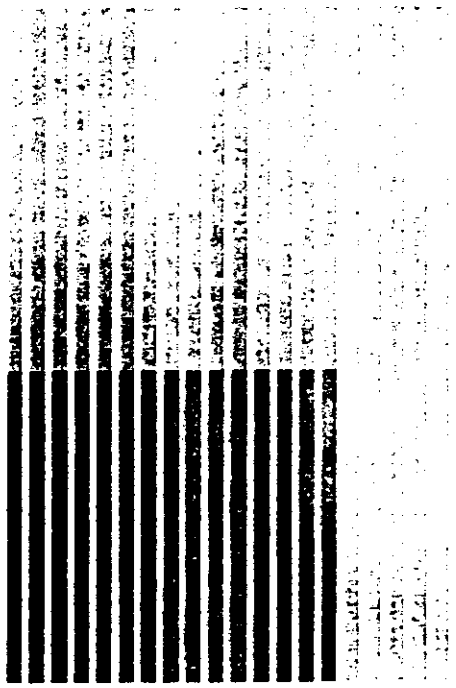

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